Categorical
Use Attainability Analysis
for Recreation

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1.0 SUMMARY

The State of Wyoming currently has two designations for recreational use of surface waters: primary contact recreation and secondary contact recreation. In addition, Wyoming has a summer recreation season (May 1 through September 30) and a winter recreation season (October 1 through April 30). Primary contact recreation waters are those where recreational activities are expected to result in full body immersion in the water (e.g., swimming, water skiing, etc.) or a level of contact with the water equivalent to swimming (i.e., activities of similar duration, intensity, and exposure to the water as swimming) during the summer recreation season. Secondary contact recreation waters are those where recreational activities are not expected to result in full body immersion in the water or a level of contact with the water equivalent to swimming (e.g., wading, fishing, hunting, etc.). During the winter recreation season (October 1 through April 30), waters designated for primary contact recreation are protected for secondary contact recreation.

Water quality criteria establish levels of pollutants necessary to support designated uses and are used in development of point source discharge permits (Wyoming Pollutant Discharge Elimination System, WYPDES); to evaluate whether water quality standards are met or exceeded (303(d) List of Impaired Waters); and to establish goals for restoration plans such as total maximum daily loads (TMDLs). Current water quality criteria to protect primary and secondary contact recreation are based on geometric mean concentrations of *Escherichia coli* (*E. coli*), an indicator of fecal contamination intended to protect swimmers from gastrointestinal illnesses caused by waterborne pathogens. The criteria are risk-based and are derived from United States Environmental Protection Agency (USEPA) recommended criteria.

As the third driest and least populous state in the U.S., Wyoming has thousands of miles of ephemeral, small intermittent, and small perennial streams and ditches that do not have sufficient water to support full body immersion that are not used for child's play with a level of contact with the water equivalent to swimming during the summer recreation season. Designating these waters for primary contact recreation results in unattainable expectations for those surface waters, unnecessarily stringent water quality criteria, and significant costs to both public and private entities to maintain and restore water quality to levels which do not correspond to the recreational uses and/or risks associated with people recreating in those waters.

After receiving many requests to change the designated use of surface waters from primary to secondary contact recreation, the Wyoming Department of Environmental Quality/Water Quality Division (WDEQ/WQD) determined that a statewide analysis would be the most effective and efficient method to determine the existing and attainable recreational uses of surface waters in Wyoming. Federal regulations and Wyoming's Surface Water Quality Standards require that the state conduct a scientific assessment of the factors affecting the attainment of the use (i.e., a use attainability analysis) in order to designate waters for secondary contact recreation. WDEQ/WQD's analysis, the Categorical Use Attainability Analysis for Recreation (Categorical UAA) used Geographic Information Systems (GIS), 871 field verification sites, and public feedback to determine which ephemeral, small intermittent, and small perennial streams and ditches do not have sufficient flow to support full body immersion that are unlikely to be used for child's play with a level of contact with the water equivalent to swimming during the summer recreation season. Lakes, reservoirs, ponds, and other still water bodies; Class 1 waters; and waters in Indian Country were not included in the analysis.

The Categorical UAA identifies low flow channels (ephemeral, small intermittent, and small perennial streams and ditches) with insufficient flow to support full body immersion as those flowlines within the 1:100,000 (100k) National Hydrography Dataset (NHD) with estimated mean annual flows (including flows from point source discharges) less than 6 cubic feet per second (cfs). These flowlines were designated for secondary contact recreation unless they occurred in areas easily accessible by small children (i.e., near populated places, schools, parks, campgrounds, rest areas, other accessible recreation sites, etc.). These low flow channels have

a higher likelihood of being used for primary contact recreation because small children are more likely to have a level of contact with the water equivalent to swimming in accessible low flow channels. Primary contact recreation was also retained on flowlines that are congressionally designated as Wild and Scenic Rivers. Isolated flowlines identified for secondary contact recreation that are adjacent to primary contact recreation flowlines were changed to primary contact recreation to avoid short, isolated reaches.

The results were validated with 151 field surveys conducted by WDEQ/WQD and 720 field surveys conducted by Wyoming's Conservation Districts. There was 95% agreement between the primary surveys and 80% agreement between all the surveys. Of Wyoming's 104,145 flowline miles depicted in the 100k NHD that were addressed in this UAA (excluding Class 1 flowlines, Indian Country flowlines, and flowlines where site-specific UAAs were previously completed), primary contact recreation is not an attainable or existing use on approximately 82,896 miles, or 79.6% of the flowlines.

Primary and secondary contact recreational use designations for 100k flowlines can be viewed on the Recreation Designated Uses Web Map: http://159.238.120.99/recreation/index.html. Recreational use designations of channels not present in the 100k NHD can be determined from the "Primary Areas" layer present in the web map. Channels not present in the 100k NHD that are located in the Primary Area layer are designated for primary contact recreation. Channels not present in the 100k NHD or in the Primary Areas layer are designated for secondary contact recreation.

2.0 BACKGROUND

As outlined in Wyoming's Surface Water Quality Standards (Water Quality Rules and Regulations, Chapter 1), Wyoming has two designated uses for recreation, primary and secondary contact recreation, and a summer recreation season (May 1 through September 30). Primary contact recreation waters are those where recreational activities are expected to result in full body immersion in the water (e.g., swimming, water skiing, etc.) or a level of contact with the water equivalent to swimming (i.e., activities of similar duration, intensity, and exposure to the water as swimming) during the summer recreation season. Secondary contact recreation waters are those where recreational activities are not expected to result full body immersion in the water or a level of contact with the water equivalent to swimming (e.g., wading, fishing, hunting, etc.). During the winter recreation season (October 1 through April 30), waters designated for primary contact recreation are protected for secondary contact recreation.

Since WDEQ/WQD implements the federal Clean Water Act in Wyoming, Wyoming's recreational designated uses and water quality criteria to protect primary and secondary contact recreational uses are consistent with the federal Clean Water Act and implementing regulations. Section 101(a)(2) of the Clean Water Act identifies a national goal that wherever attainable, water quality which provides for recreation in and on the water. In circumstances where swimmable uses (i.e., primary contact recreation) are not attainable or existing uses, states can modify the recreational use by conducting a structured scientific assessment of the factors affecting the attainment of the use, called a use attainability analysis (UAA). Factors may include physical, chemical, biological, and economic considerations.

Water Quality Criteria for Recreational Uses

EPA's recommended water quality criteria for primary contact recreation are based on studies that evaluate the relationship between water quality and illnesses in ***swimmers***. The recommended criteria are risk-based and have been defined as a "quantifiable relationship between the density of the indicator in the water and the potential human health risks involved in the water's use" (Cabelli 1981 cited in Dufour 1984). The relationships are used "to determine not what the risk is but what the water quality should be after an acceptable level of risk has been agreed upon by a local or state authority" (Dufour 1984).

In 2001, all surface waters in Wyoming were designated for "full body contact recreation" (WDEQ/WQD 2001). Wyoming's criteria to protect "full body contact recreation" were derived from EPA's 1976 recommended water quality criteria and consisted of geometric mean[1] concentrations of fecal coliforms. EPA's 1976 Quality Criteria recommended fecal coliform concentrations to define "swimming quality" and were based on the "incidence of illness observed among swimmers" who used freshwater beaches at Lake Michigan in Chicago, Illinois and the Ohio River in Dayton, Kentucky (EPA 1976). These recommended criteria were based on a risk level of approximately 8 gastrointestinal illnesses per 1,000 swimmers (EPA 1986).

Fecal coliforms were used as indicators of fecal contamination, with the underlying premise that waterborne pathogens (e.g., viruses, bacteria, parasites, protozoa, etc.) that cause gastrointestinal illnesses (nausea, diarrhea, vomiting) in swimmers are more likely to occur in surface waters with fecal contamination (EPA 1976). Pathogen indicators, rather than the pathogens themselves, are used as recommended water quality criteria due to the diversity of potential pathogens present in surface waters.

Wyoming used EPA's 1976 recommended geometric mean concentrations of 200 colony-forming units (CFUs) of fecal coliforms per 100 milliliters of water (CFU/100 mL) to protect Wyoming surface waters designated for "full body contact recreation" until 2007.

In 2007, Wyoming's Surface Water Quality Standards were revised to include "primary contact recreation" as the designated use rather than "full body contact recreation;" add a summer recreation season (May 1 through September 30) during which the primary contact criteria apply; and add water quality criteria for secondary contact recreation. Numeric water quality criteria for recreational uses were also revised from geometric mean concentrations of fecal coliforms to geometric mean concentrations of *E. coli* based on EPA's Ambient Water Quality Criteria for Bacteria – 1986 (EPA 1986).

EPA's Ambient Water Quality Criteria for Bacteria – 1986, Bacterial Ambient Water Quality for Marine and Fresh Recreational Waters were based on data obtained during a multi-year freshwater epidemiological research program conducted at freshwater beaches near Erie, Pennsylvania and Tulsa, Oklahoma between 1978 and 1982 (Dufour 1984; EPA 1986). The goals of these studies were to: "determine whether swimming in freshwater contaminated sewage effluents results in a higher rate of gastrointestinal illness in swimmers related to the rate observed in beach-going, non-swimming reference group" (Dufour 1984); "determine which bacterial indicator is best correlated to swimming-associated health effects;" and define a "quantitative relationship between the water quality indicator and a swimming-associated health effect" (EPA 1986).

Swimming in these studies was "rigidly defined as having all upper body orifices exposed to the water" with interviewers "instructed to observe the individuals they were interviewing for signs of complete body immersion such as wet hair." Also noted in the study, "beach goers at freshwater beaches have a tendency to go into the water for extended periods and to immerse their bodies totally in the water" (Dufour 1984).

EPA's 1986 criteria recommended a change in fecal indicator from fecal coliforms to *E. coli* and/or enterococci because the epidemiological studies showed no correlation between gastrointestinal illness rates in swimmers and concentrations of fecal coliforms (Dufour 1984; EPA 1986). Similar to fecal coliforms, indicator organisms such as *E. coli* or enterococci are used to infer that pathogens that cause gastrointestinal illnesses in swimmers may be present. Most strains of *E. coli* are harmless (CDC 2016).

[1]A geometric mean is the nth root of the product of n numbers. A geometric mean is used to determine the central tendency of a group of numbers that can vary widely and dampens the effect of very high or very low values that would bias an arithmetic mean.

Wyoming's current criteria to protect primary contact recreation are based on EPA's 1986 recommended water quality criteria of a geometric mean of 126 CFU/100 mL *E. coli* (EPA 1986). EPA's 1986 recommended water quality criteria retained the same illness rate as the 1976 criteria, approximately 8 illnesses per 1,000 swimmers. Therefore, Wyoming's primary contact recreation criteria of a 60-day geometric mean of 126 CFU/100 mL *E. coli* correspond to a potential illness rate of 8 per 1,000 swimmers. The secondary contact recreation criteria of a 60-day geometric mean of 630 CFU/100 mL *E. coli* are derived from the same studies as the primary contact recreation criteria and correspond to a potential illness rate of 15 per 1,000 swimmers[2] (i.e., 0.8% of swimmers for primary contact recreation versus 1.5% of swimmers for secondary contact recreation). Secondary contact recreation is an appropriate level of protection for Wyoming's low flow channels where swimming or similar water contact activities are not feasible or existing uses because the exposure potential to waterborne pathogens is substantially reduced.

The study design used during development of EPA's 1986 criteria was also the basis for EPA's 2012 Recreational Water Quality Criteria. In the 2012 document, EPA defines primary contact recreation as "typically includes activities where immersion ***and*** ingestion are likely ***and*** there is a high degree of bodily contact with the water, such as swimming, bathing, surfing, water skiing, tubing, skin diving, water play by children, or similar water-contact activities" (EPA 2012). EPA's 2012 recreation criteria also describes that "an important goal of the CWA [Clean Water Act] is to protect and restore waters for swimming". WDEQ/WQD will be evaluating EPA's 2012 Recreational Water Quality Criteria for inclusion during the next revision of Wyoming's Surface Water Quality Standards.

Summer and Winter Recreational Seasons

For waters designated for primary contact recreation, water quality criteria to protect primary contact recreation activities apply during the summer recreation season and water quality criteria to protect secondary contact recreation activities apply during the winter recreation season. For waters designated for secondary contact recreation, water quality criteria protective of secondary contact recreation apply year round.

The summer and winter recreation seasons were adopted to recognize that low ambient air and water temperatures in Wyoming during the winter recreation season (October 1 through April 30) make swimming and similar water contact activities unlikely. As noted in EPA's approval of Wyoming's 2007 seasonal recreational uses, "seasonal uses recognize the practical reality that wintertime conditions are not conducive to primary contact recreation activities and provide for appropriate levels of protection" (EPA 2008). EPA's water quality standards handbook provide the example that "in many northern areas, body contact recreation is possible only a few months out of the year. Several states have adopted primary contact recreational uses, and the associated microbiological criteria, for only those months when primary contact recreation actually occurs, and have relied on less stringent secondary contact recreation criteria to protect for incidental exposure in the 'non-swimming' season" (EPA 1994).

Origins of the Categorical UAA for Recreation

In addition to the change in indicator organisms from fecal coliforms to *E. coli*, the addition of the summer recreation season and water quality criteria for secondary contact recreation, also in 2007, "all waters not specifically listed in Table A of the Wyoming Surface Water Classification List" were designated for secondary contact recreation. EPA disapproved these secondary contact recreation designations because the designations had been made without conducting a use attainability analysis. As outlined in federal regulations, 40 Code of Federal Regulations (CFR) § 131.10(g), "States may designate a use, or remove a use that is not an existing use, if the State conducts a use attainability analysis…" "…that demonstrates that the use is not

[2] Illness rates based on EPA's 1986 recreation criteria. EPA's 2012 recommended criteria re-defined gastrointestinal illness; under the revised definition, illness rates for Wyoming's primary and secondary contact criteria correspond to 36 per 1,000 swimmers and 68 per 1,000 swimmers, respectively.

feasible because of one of the six factors…" EPA outlined that in order to resolve the disapproval, "the State will need to delete the language in Section 27(a)" and "for waters where the State believes that further review of the appropriate recreation use is warranted, the best option would be to utilize the Wyoming DEQ's Recreational Use Designations Use Attainability Analysis (UAA) Worksheet on a site-specific basis"… or "another option……would be to work with the Region to develop a categorical UAA" (EPA 2008).

WDEQ/WQD initiated the Categorical UAA in response to many requests to change the designated use of waters from primary contact recreation to secondary contact recreation. Between 2007 and 2010, WDEQ/WQD received requests from the South Goshen, Lingle-Fort Laramie, North Platte Valley, Hot Springs, Washakie County, Lower Wind River, and Popo Agie Conservation Districts to designate hundreds of miles of streams for secondary contact recreation. In addition to these UAA submissions, WDEQ/WQD was notified that many more site-specific UAAs would be forth coming. WDEQ/WQD has limited staff and resources to process hundreds of site-specific UAAs and therefore, in 2009, began working on what resulted in the Categorical UAA. In 2010, WDEQ/WQD and Wyoming's Conservation Districts conducted field visits and completed surveys at 871 sites to validate the UAA. The Categorical UAA was determined to be the best way to: accommodate the overwhelming public interest in appropriately designating recreational uses and applying water quality criteria to waters of the state; maximize the resources of the state by effectively, efficiently, and consistently determining existing and attainable recreational uses on surface waters in Wyoming; and reduce the number of site-specific UAAs that would need to be processed.

Requests to modify recreational designated uses were made so that designated uses and applicable water quality criteria more closely matched how surface waters are actually used and could potentially be used in order to ensure that resources are used appropriately to restore and protect surface water quality.

Surface water quality standards, specifically designated uses and criteria to protect designated uses, establish acceptable levels of pollutants for surface waters to ensure that designated uses are met. Pollutant levels are used to: establish permit limits for point source discharges, determine whether waters are meeting their designated uses, and set restoration targets when pollutant levels need to be reduced. Waters found to not meet their designated uses are identified on Wyoming's 303(d) List of Impaired Waters and are scheduled for Total Maximum Daily Load (TMDL) development. TMDLs evaluate the contribution of pollutants from both point sources and nonpoint sources and establish a plan to meet water quality standards through pollutant reductions.

Developing TMDLs is resource intensive and costly for both DEQ and stakeholders. Each TMDL requires extensive public participation, monitoring of surface waters, estimation of the loading capacity of the water, evaluation of pollutant loading from all sources, analysis of the current pollutant loads, determination of needed reductions, and an allocation of the allowable pollutant load among the different pollutant sources in a manner that ensures water quality standards are achieved. Upgrades to water treatment processes can be required and planning and implementation of potential best management practices requires significant involvement and commitments from local stakeholders.

Wyoming stakeholders are not unique in wanting to appropriately designate recreational uses on surface waters. A 2006 study by Meyerhoff et al. reviewed how each state designates recreational uses and how criteria to protect those uses are applied. The study highlighted that the TMDL process has increased interest in ensuring that recreational use designations are applied correctly. The review cites a survey of state regulators that found that "nearly half of all 303(d) Listings may not have been necessary if there had been a quick and cost-effective way to revise water quality standards to more accurately reflect the true use potential of waterbodies." The review also identifies that no two states have implemented bacterial standards using the same approach and that the EPA has approved a multitude of approaches, including some that are

substantially different from the recommendations contained in federal guidance. Many states have waters designated primary and secondary contact recreation, similar to Wyoming's approach, while other states have additional recreational use designations, including waters with no protection for recreation (Meyerhoff et al. 2006).

Coordination with EPA, UAA Development and Revision, and Public Participation

WDEQ/WQD coordinated with EPA Region 8 throughout the conception and development of the Categorical UAA. EPA provided input on early versions of DEQ's approach and staff accompanied WDEQ/WQD during field visits to complete surveys in July 2010. In February 2012, WDEQ/WQD submitted a preliminary draft of the Categorical UAA to EPA Region 8 for feedback. In a May 2012 comment letter, EPA Region 8 outlined that their main concern with the draft categorical UAA was the lack of connection to the use removal factors outlined in Chapter 1, Section 33(b) and the federal regulations, 40 CFR § 131.10(g). To address EPA's concerns, WDEQ/WQD developed an approach to identify waters which do not support primary contact recreation based on factor 2 (Chapter 1, Section 33(b)(ii) and 40 CFR § 131.10(g)(2)), the "low flow" factor. WDEQ/WQD then submitted an *Identification of Low Flow Streams* analysis to EPA in October 2012. EPA provided feedback in January 2013 indicating that their "preliminary thinking is that WDEQ's draft approach for identifying streams with insufficient flow to support primary contact recreation, with some modification, would be consistent with 40 CFR § 131.10(g)(2)."

WDEQ/WQD considered EPA Region 8 feedback on both the February 2012 *Draft Categorical Use Attainability Analysis for Recreation* and the October 2012 *Identification of Low Flow Streams* analysis and released the *Draft Categorical Use Attainability Analysis for Recreation* for public comment on August 6, 2013. The Categorical UAA identified low flow channels (ephemeral, small intermittent, and small perennial streams and ditches) with insufficient flow to support full body immersion as those flowlines within the 100k NHD with estimated mean annual flows less than 6 cubic feet per second (cfs). These flowlines were designated for secondary contact recreation unless they occurred in areas easily accessible by small children (i.e., near populated places, schools, parks, accessible recreation sites, etc.) since small children are more likely to have contact with the water equivalent to swimming in accessible low flow channels. The public notice identified that the state needed assistance from the public to identify channels in Wyoming that are used for primary contact recreation that were not identified as primary in the draft UAA. The public notice specifically identified areas such as pools or other deep water areas that may occur on low flow channels that may be used for primary contact recreation. WDEQ/WQD also requested assistance in identifying any potential issues with the datasets used in the draft UAA.

During the August 6, 2013 to September 30, 2013 comment period, WDEQ/WQD did not receive any comments indicating that there were pools or other deep water areas on "low flow" channels used for primary contact recreation. WDEQ/WQD did receive comments indicating that the access datasets were designating too many dry draws and gullies for primary contact recreation that were not used for, nor have the potential to be used for, primary contact recreation (see Categorical Use Attainability Analysis for Recreation Response to Comments for Comment Period Ending September 30, 2013 for the full text of the comments and responses). Based on these and other comments received during the August 6 – September 30, 2013 public comment period, WDEQ/WQD released a revised *Categorical Use Attainability Analysis for Recreation* for a 45-day public comment period on January 28, 2014. Minor changes were made to the UAA (see Categorical Use Attainability Analysis for Recreation Response to Comments for Comment Period Ending March 14, 2014 for the full text of comments and responses) and on August 20, 2014, the Water Quality Division Administrator issued a final determination designating ephemeral, small intermittent, and small perennial streams and ditches not located near populated areas, schools, or accessible recreation sites identified in the August 2014 Categorical UAA for secondary contact recreation.

WDEQ/WQD submitted the revised recreation designations to EPA in December 2015. Although EPA has not previously required WDEQ/WQD to hold a hearing on changes to designated uses, in a June 2015 letter, EPA notified WDEQ/WQD that "in order for EPA to approve any of the recreation designated uses that are consistent with CWA requirements, the state must first hold a public hearing consistent with CWA § 303(c)(1) and the EPA's implementing regulations at 40 CFR Parts 25 and 131." In response to EPA's request, WDEQ/WQD provided notice and held a public hearing on September 16, 2015, in Casper, Wyoming. In addition, WDEQ/WQD accepted written comments on the Categorical UAA for a third time during this period.

This document describes the analysis that was used to identify channels in the state where primary contact recreation is not an existing or attainable use and therefore can be designated for secondary contact recreation. The analysis reflects public feedback received during three written comment periods, a public meeting, as well as a public hearing. Individual flowline designations and the GIS datasets used in the analysis can be accessed from the Recreation Designated Uses Web Map: http://159.238.120.99/recreation/index.html. Shapefiles of the designations can also be downloaded from surface water quality webpage: http://deq.wyoming.gov/wqd/surface-water-quality-standards/resources/uaas/.

2.1 Use Attainability Analysis Process

Chapter 1, Section 4 describes the classes and designated uses for surface waters in Wyoming and Section 33 outlines the process to modify designated uses and develop site-specific criteria. Section 33 specifies that "the administrator may lower a classification, remove a designated use which is not an existing nor attainable use, establish ambient-based criteria on effluent dependent waters, make a recommendation to the council to establish sub-categories of a use or establish site-specific criteria if it can be demonstrated through a use attainability analysis (UAA) that the original classification, designated use or water quality criteria are not feasible because:

(i) Naturally occurring pollutant concentrations prevent the attainment of the classification or use; or

(ii) Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating state water conservation requirements to enable uses to be met; or

(iii) Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or

(iv) Dams, diversions, or other types of hydrologic modifications preclude the attainment of the classification or use, and it is not feasible to restore the water body to its original condition or to operate such modification in such a way that would result in the attainment of the classification or use; or

(v) Physical conditions related to the natural features of the water body such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude the attainment of an aquatic life use; or

(vi) Controls more stringent than those required in Section 301(b) and 306 of the Federal Act would result in substantial and widespread economic and social impact. This subsection shall not apply to the derivation of site-specific criteria" (WDEQ/WQD 2013a).

The six removal factors outlined above are derived from 40 CFR § 131.10(g), which outline that "States may designate a use, or remove a use that is *not* an existing use, if the State conducts a use attainability analysis as specified in § 131.10(j) that demonstrates attaining the use is not feasible because of one of the six factors in this paragraph." As outlined in both state and federal regulations, a UAA must utilize these six factors to demonstrate that a use is not attainable and therefore can be removed. Chapter 1 and federal regulations define UAAs similarly; Chapter 1, Section 2(b)(li) defines a UAA as "a structured scientific assessment of the factors affecting the attainment of the use. The factors include physical, chemical, biological, and economic factors as described in Section 33 of these regulations" (WDEQ/WQD 2013a).

Section 2.9 of the EPA's *Water Quality Standards Handbook*[3] discusses the ability of states to conduct UAAs for groups of waters, referred to here as a categorical UAA. The handbook outlines that "States may also conduct a generic use attainability analysis for groups of water body segments provided that the circumstances relating to the segments in question are sufficiently similar to make the results of the generic analyses reasonably applicable to each segment."

2.2 Wyoming Guidance on Recreation Use Attainability Analyses

Additional guidance for UAAs in Wyoming is provided in the *Use Attainability Analysis Implementation Policy* (WDEQ/WQD 2013b). Section 7 of the policy outlines the UAA process for Recreation Designations; the policy also includes a Recreational Use Designations Use Attainability Analysis (UAA) Worksheet. The policy outlines that "[t]he decision as to whether a water body is most appropriately designated for primary or secondary recreation protection is not intended to be a difficult one. There are only a few factors relating to water availability, access and recreational opportunity that need to be considered." The policy also outlines that waters "located within federal, state or local parks and recreation areas;" waters "known to be used for primary contact recreation activities such as swimming, rafting, floating, canoeing or kayaking;" "all lakes and reservoirs located in the state already used or have the potential to be used for primary contact recreation;" "waters located within or flow through municipalities or high density housing areas;" and "larger perennial streams and game fisheries" will generally be designated for primary contact recreation.

2.3 EPA Guidance on Recreation Use Attainability Analyses

EPA has published at least two guidance documents that address recreation UAAs. The first was published in 1992 by EPA Region 8 and titled *Recreation Standards and the CWA Section 101(a)(2) 'Swimmable' Goal*. The second was published in 2004 by EPA and titled *Implementation Guidance for Ambient Water Quality Criteria for Bacteria* (EPA 2004). These guidance documents outline that protection for primary contact recreation is not necessary on every water and address when it is appropriate to assign less than swimmable uses to waters.

The 1992 Region 8 guidance outlines that "although assigning swimmable goal standards to all waters would clearly satisfy all requirements pertaining to recreation and fully protect public health, Region VIII recognizes that there may be some waterbodies where application of such standards may be unnecessary. For example, in situations where an evaluation of the relevant factors indicates that existing and potential primary contact recreation uses cannot reasonably be presumed to exist, it may not be necessary or appropriate to set standards in support of the swimmable goal" (EPA 1992). Similarly, the 2004 EPA guidance outlines that "where a state or authorized tribe has determined that primary contact recreation is not an existing use as defined by federal and state (or tribal) regulations, nor attainable for one of the reasons identified in the

[3] http://water.epa.gov/scitech/swguidance/standards/handbook/chapter02.cfm#section9

federal and state (or tribal) regulations, states and authorized tribes may adopt other categories of recreation such as intermittent primary contact recreation, wildlife impact recreation, or secondary contact recreation" (EPA 2004).

The 1992 Region 8 guidance outlines four options to achieve compliance with the requirements associated with the swimmable goal, one of which is to "conduct and submit to EPA for review use attainability analyses (UAAs) for all waters where recreation standards are not consistent with the CWA Section 101(a)(2) goal." Similarly, Section 3.5.1 of EPA's 2004 guidance identifies that "states and authorized tribes may assign less than 'swimmable' standards where adoption of such a standard is adequately justified by a use attainability analysis (UAA)" (EPA 2004). The 1992 guidance outlines that "In the case of potential uses, the decision must be based on consideration of a variety of factors affecting potential (e.g., access, flow, depth)" (EPA 1992). The 2004 guidance states that "less than 'swimmable' standards may be considered, for example, where flowing or pooled water is not present within a waterbody during the months when primary contact recreation would otherwise take place and the waterbody is not in close proximity to residential areas, thereby indicating that primary contact uses are not likely to occur. Also, if a state or authorized tribe can demonstrate that natural, ephemeral, intermittent, or low flow condition or water levels prevent attainment of the primary contact recreation use, a secondary contact recreation use may be appropriate" (EPA 2004).

2.4 Wyoming's Categorical Use Attainability Analysis for Recreation

Based on EPA's recommended water quality criteria for primary contact recreational waters, the design of the studies upon which the criteria are based, primary contact waters are generally considered to be **waters that are used for or can be used for swimming or similar water contact activities (i.e., waters where contact with the water is equivalent to swimming, or activities of similar duration, intensity, and exposure to the water as swimming) during the summer recreation season**. Surface waters that are not used for or capable of supporting swimming or where contact with the water is not equivalent to swimming during the summer recreation season are more appropriately designated for secondary contact recreation. Use of surface waters as a water supply, for activities such as showering; cooking; cleaning pots, pans and eating utensils; brushing teeth; rinsing clothes; and drinking water are not considered recreational uses.

As articulated in federal and state regulations and guidance, assigning secondary contact recreation uses where primary contact recreation is not an attainable or existing use through a categorical UAA is consistent with the Clean Water Act. To comply with federal and state regulations and guidance on recreation UAAs, this UAA combines an evaluation of: water availability (low flow conditions – factor 2), outlined in Chapter 1, Section 33(b)(ii) and 40 CFR § 131.10(g)(2); access, mentioned in Wyoming's *Use Attainability Implementation Policy* (WDEQ/WQD 2013b) and EPA guidance documents (EPA 1992; EPA 2004); and whether primary contact recreation is an existing use, as outlined in Chapter 1, Section 33(b) and 40 CFR § 131.10(g).

As a first step, the UAA uses GIS datasets to identify ephemeral, small intermittent, and small perennial streams and ditches (low flow channels) that do not support primary contact recreation because "natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating state water conservation requirements to enable uses to be met" (40 CFR § 131.10(g)(2)). Because there is little information available in GIS to identify whether a still water body (lake, reservoir, pond, etc.) has sufficient water to support primary contact recreation, still water bodies are not addressed in this UAA.

As a second step, the UAA uses additional GIS datasets (i.e., populated places, schools, parks, accessible recreation sites) to identify low flow channels with the greatest likelihood of being used for water play by small children with a level of contact with the water equivalent to swimming because the channels are located in

areas easily accessible to small children. The areas with the highest likelihood of water play by small children are consistent with those identified in Wyoming's Recreational Use Designations Use Attainability Analysis (UAA) Worksheet, including parks, recreation areas, high density housing areas, schools, etc. (WDEQ/WQD 2013b). Although these channels will generally not support full body immersion since they are low flow, they are the most likely to be used by small children for water play with a level of contact with the water equivalent to swimming.

In the third step, the UAA incorporates public feedback received during three written comment periods, public meeting, and public hearing. Public feedback focused on whether primary contact recreation is an existing use in areas other than those identified in steps one and two. These areas included any pools, deep water areas, or other sites located on low flow channels not identified in the GIS datasets. Based on the feedback received during the three written comment periods, public meeting, and public hearing, there are not any pools or deep water areas located on low flow channels used for primary contact recreation designated for secondary contact recreation in the UAA.

For low flow channels where the UAA indicates there is not sufficient water availability (low flow conditions) to support full body immersion, not sufficient access to make regular water play by small children likely, and public feedback has not indicated that the channel is used for primary contact recreation, primary contact recreation is presumed not to be an existing or attainable use and can be removed. The remaining low flow channels that are not proximate to areas easily accessible to small children can be grouped together categorically since the conditions that most influence the recreational use of the channels are sufficiently similar. These channels will be designated for secondary contact recreation.

Exceptions to the above process include waters in Indian Country, as defined at 18 U.S.C. Section 1151; Class 1 waters; and congressionally designated Wild and Scenic Rivers. EPA or authorized tribes administer the Clean Water Act in Indian Country, therefore the Categorical UAA has not been applied to waters in Indian Country (3,172 flowline miles). Class 1 waters are specifically designated by the Environmental Quality Council to maintain and protect the water quality and physical and biological integrity which existed on the water at the time of designation. As such, Class 1 waters are not assigned designated uses (8,059 flowline miles). WDEQ/WQD has retained primary contact recreation on all waters congressionally designated as Wild and Scenic Rivers (4 flowline miles) that were not identified as primary through the Categorical UAA.

3.0 LOW FLOW CHANNELS

Low flow channels in which "natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the" primary contact recreation use were identified to fulfill the regulatory requirements in Chapter 1, Section 33(b)(ii) and 40 CFR § 131.10(g)(2) and to maintain consistency with Wyoming's *Use Attainability Analysis Implementation Policy* and EPA's 1992 and 2004 guidance on recreation UAAs.

3.1 Recreation UAAs Based on 131.10(g)(2)

EPA Regions 6 and 7 have approved recreation UAAs based on 40 CFR § 131.10(g) factor 2. Documentation that was previously located on the EPA Region 6 website regarding recreation UAAs identified that "Region 6 has allowed factor 2 to be used whenever this lack of flow results in water depths of less than 18 inches (1.5 feet). Arkansas, in their ecoregion analysis, found that waterbodies with watersheds of less than 10 sq. mi. also did not support a swimming use and the region has approved this approach too." The section on physical conditions in EPA Region 8's Recreation UAA Worksheet asks whether "any portions of the segment ever provide sufficient flow and/or depth for total body immersion (in a prone position)" (EPA 1994).

EPA Region 7 has used a similar approach to Region 6, where states such as Iowa, Kansas, and Missouri have used stream depth to demonstrate that primary contact recreation is not attainable based on 131.10(g) factor 2. An EPA action letter to Iowa dated June 29, 2010 describes that the Iowa Department of Natural Resources (IDNR) "assigned a secondary contact recreational use to water bodies where the maximum depth measurements were less than one meter or the average depth was less than 0.5 meters and no other information indicated that primary contact recreation was attainable" (EPA 2010). Missouri's 2007 Recreational Use Attainability Analysis protocol[4] describes that a maximum depth of at least one meter (3.28 ft) or a median depth of at least one-half meter (1.64 feet) must be maintained during base flow conditions in the survey area in order to support whole body contact recreation. Therefore, waters designated for secondary contact recreation will have a median depth of less than 0.5 meters (1.64 ft) and a maximum depth less than one meter (3.28 ft). Missouri's protocol defines base flow conditions as the "portion of stream flow contributed by sources of water other than precipitation runoff. This refers to a fair weather flow sustained primarily by springs or groundwater seepage, wastewater discharges, irrigation return flows, releases from reservoirs, or some combination of these sources." Median depth is calculated by measuring depth at cross-sections spaced equidistantly throughout a segment (MDNR 2007).

3.2 Wyoming Climate

From 1971 to 2000, Wyoming was the third driest state in the U.S.; only Nevada and Utah were drier. Mean annual precipitation was 12.97 inches[5]; 30% of the state received less than 12 inches of precipitation per year and 67% of the state received less than 16 inches of precipitation per year (USDA/NRCS 2006; Figure 1). Precipitation ranged from 5 inches per year in the central basin areas to 93 inches per year in the mountainous areas of northwestern Wyoming. As a result of the dry climate in large portions of Wyoming, most channels in the state do not have sufficient flow to support primary contact recreation. These are ephemeral, small intermittent, or small perennial streams and ditches, the majority of which are located in the basin areas of the state. Ephemeral, small intermittent, or small perennial streams and ditches may also occur in mountainous areas of the state where streams have small watershed areas and/or surface water moves rapidly to groundwater. Streams with larger watershed areas that originate in mountainous areas with high mean annual precipitation, where water does not move rapidly to groundwater, will generally be larger perennial streams that may have sufficient flow to support primary contact recreation.

3.3 Identification of Low Flow Channels in Wyoming

Based on EPA-approved recreation UAAs, both depth and watershed area have been used to identify "low flow" streams. Because WDEQ/WQD is using a Geographic Information Systems (GIS) based approach to identify low flow channels where primary contact recreation is not an attainable use, the UAA is limited to attributes represented in the GIS.

3.3.1 National Hydrography Dataset

The National Hydrography Dataset[6] (NHD) is a comprehensive set of digital spatial data that represents the surface water of the United States using common features such as lakes and ponds (i.e., waterbodies), as well as streams, rivers, canals, and ditches (i.e., flowlines). The NHD is available in two seamless datasets; one

[4] Missouri Recreation UAA Protocol: https://dnr.mo.gov/env/wpp/wqstandards/uaa/docs/wpp_wqs_uaa.pdf
[5] Earth Systems Research Laboratories: http://www.esrl.noaa.gov/psd/data/usclimate/pcp.state.19712000.climo
[6] National Hydrography Dataset: http://nhd.usgs.gov/index.html

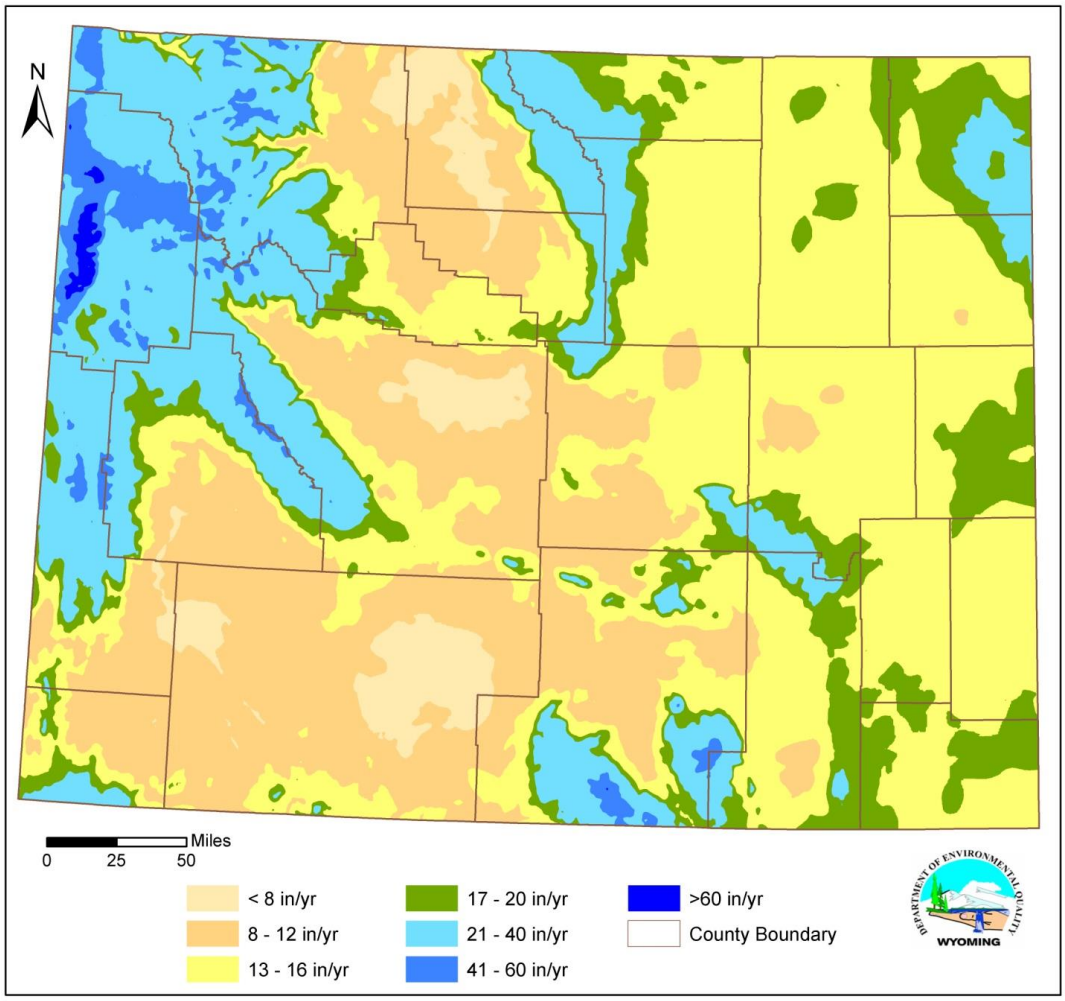

Figure 1. Mean annual precipitation for Wyoming 1971-2000.

based on 1:24,000-scale (24k) topographic mapping, known as the high-resolution NHD, and the other based on 1:100,000-scale (100k) topographic mapping, known as the medium resolution NHD (Simley and Carswell 2009). The 100k and 24k NHD flowline datasets contain one attribute associated with flow, hydrologic classifications of perennial, intermittent and ephemeral, but these are general classifications that lack sufficient accuracy to determine whether the channel is capable of supporting full body immersion.

Additional attributes contained in NHDPlus[7] that are more direct estimates of flow can be joined to the 100k NHD dataset. NHDPlus is "an integrated suite of application-ready geospatial data products, incorporating many of the best features of the National Hydrography Dataset (NHD), the National Elevation Dataset (NED), and the National Watershed Boundary Dataset (WBD)" (McKay et al. 2013). Version 1 of NHDPlus was first released in 2006 and Version 2 (V2) of NHDPlus was released in 2012. NHDPlus V2 includes one direct measure of flow for channel segments represented in the 100k NHD, mean annual flow estimates (MAF), and two indirect measures of flow, watershed area and stream order.

Stream Order

Stream order is a classic method for ranking streams according to size. NHDPlus V2 stream order is based on a modification of the Strahler Method. The Strahler Method was developed by Arthur Strahler to characterize

[7] NHDPlus: http://www.horizon-systems.com/NHDPlus/index.php

the relative size of streams (McKay et al. 2013). The NHDPlus V1 Strahler order calculation metadata (NHDPlus 2005) describes stream order as "stream order follows dendritic networks from headwaters to the river outflow. At headwaters, stream/rivers are assigned a Strahler order of one (1st order). When two 1st order streams flow together, the downstream feature is assigned a Strahler order of two (2nd order). Only when two features of the same order flow together does the Strahler order increment to the next larger order." The concept is applied similarly in NHDPlus V2. Pierson et al. (2008) describes that perennial and intermittent streams are included in determining Strahler order. The stream order NHDPlus V1 metadata (NHDPlus 2005) also describes that "Strahler order is used in water-related research to represent relative flow." Strahler stream order therefore generally identifies channels smallest in cross sectional area and mean annual flow as 1st order, channels with slightly larger cross sectional area and mean annual flow as 2nd order, and so on. Approximately 9,062 of the 104,145 100k flowline miles addressed in this UAA have a stream order of zero. These flowlines are generally isolated reaches; canals and ditches; or tributaries to canals and ditches. Because flowline segments with a zero order are not part of the cumulative flow path used to estimate mean annual flows, these segments also have mean annual flow estimates of zero.

Watershed Area

Watershed area, known as total upstream cumulative drainage area in NHDPlus V2, is the cumulative drainage area at the downstream end of a flowline (McKay et al. 2013). WDEQ/WQD compared the drainage area estimates within NHDPlus V2 to watershed areas of 257 USGS gage sites in Wyoming. NHDPlus estimated the drainage area of gaged sites extremely well ($R^2 = 0.99$; Figure 2).

Mean Annual Flow

Mean annual flow is the arithmetic mean of all of the individual daily mean flows for a given water year at a specific site on a river. NHDPlus V2 uses two methods to estimate mean annual flow (MAF) for each flowline segment in the 100k NHD, Enhanced Unit Runoff Method (EROM) and Vogel.

EROM uses a 6-step flow estimation process. In step one, unit runoff is computed from a 900 m runoff grid produced from a flow balance model. The flow balance model represents average conditions and takes precipitation, potential evapotranspiration (PET), evapotranspiration (ET), and soil moisture storage into account. PET and ET calculations include air temperature. In step two, a "losing stream methodology is incorporated that estimates stream flow losses that can occur due to excessive evapotranspiration in the stream channels." In step three, Falcone reference gages are used to adjust the flow estimates. In step four, flow transfers, withdrawals and augmentation are accounted for. In step five, flows upstream of a gage are adjusted to the observed flow at gage sites; however, only gages that meet certain criteria are used to perform the adjustment. In step six, a proportion of the gages are randomly removed from the gage adjustment process, which then provides a basis for an estimate of the accuracy of the flow estimates created in step 5 (McKay et al. 2013).

The Vogel method estimates mean annual flow using a log-log regression approach based on drainage area, precipitation, temperature data and mean annual flow values from the Hydro-Climatic Data Network (HCDN) of gages. The HCDN gages are minimally affected by human activities such as reservoirs, intakes and irrigation withdrawals, so the Vogel estimates are most representative of "natural" flow conditions. With the Vogel method, flow estimates are only valid within the ranges of the original data used for computing the regressions. Therefore, no Vogel estimates are available for drainage areas that fall outside these ranges (McKay et al. 2013). In Wyoming, approximately 58% of 100k flowlines do not have Vogel mean annual flow estimates in NHDPlus V2.

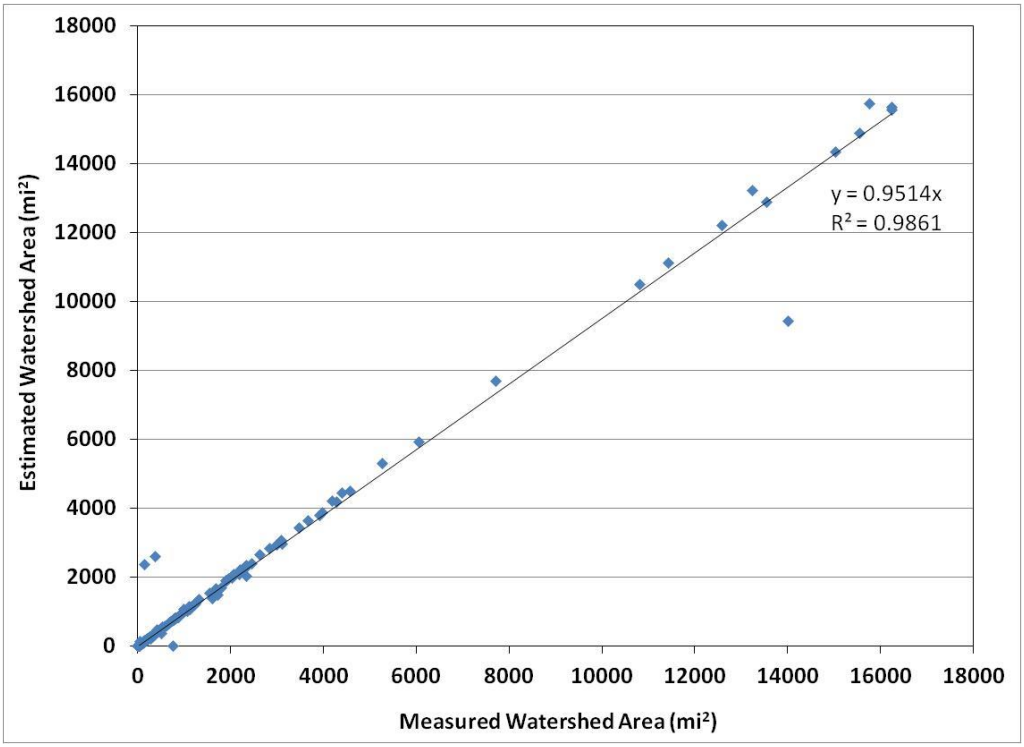

Figure 2. Watershed area at 257 USGS gage sites and watershed area at these same sites estimated by NHD*Plus* Version 2.

257 USGS gage sites in Wyoming were used to evaluate whether the Vogel or EROM mean annual flow estimates were more accurate (Figure 3). The period of record for these gages ranged from 10 to 100 years. EROM estimates were used at gage sites without Vogel estimates for the EROM and Vogel comparison. Because EROM MAF estimates were calibrated using some USGS gage sites, 68 calibration gages were removed from the analysis to avoid bias in the results. Based on the remaining 189 gages, EROM mean annual flow estimates were more accurate than the combined EROM and Vogel mean annual flow estimates (Figures 4 and 5; $R^2 = 0.86$ versus $R^2 = 0.84$). EROM method estimated mean annual overestimated measured mean annual flows at USGS gages; EROM mean annual flow estimates were approximately 1.2 times the mean annual flows measured at USGS gages.

3.3.2 Mean Annual Flows of Channels With Insufficient Flow to Support Full Body Immersion

WDEQ/WQD evaluated each of the three attributes available in NHDPlus (stream order, watershed area, and mean annual flow) and determined that due to the large variability in precipitation from one region of the state to another and corresponding variability in hydrologic regimes, mean annual flow estimates were the most accurate attribute to identify flowlines with insufficient flow to support full body immersion. Because NHDPlus is only available for the 100k NHD, the other surrogates for flow, stream order and watershed area, were used to evaluate the flow conditions of channels not present in the 100k NHD.

Channels that lack sufficient flow to support full body immersion will generally fall into one of four categories in Wyoming: ephemeral streams; small intermittent streams; small perennial streams; and small ditches. Ephemeral streams are those that "flow only in direct response to a single precipitation event in the immediate watershed or in response to a single snow melt event, and which the channel bottom is always

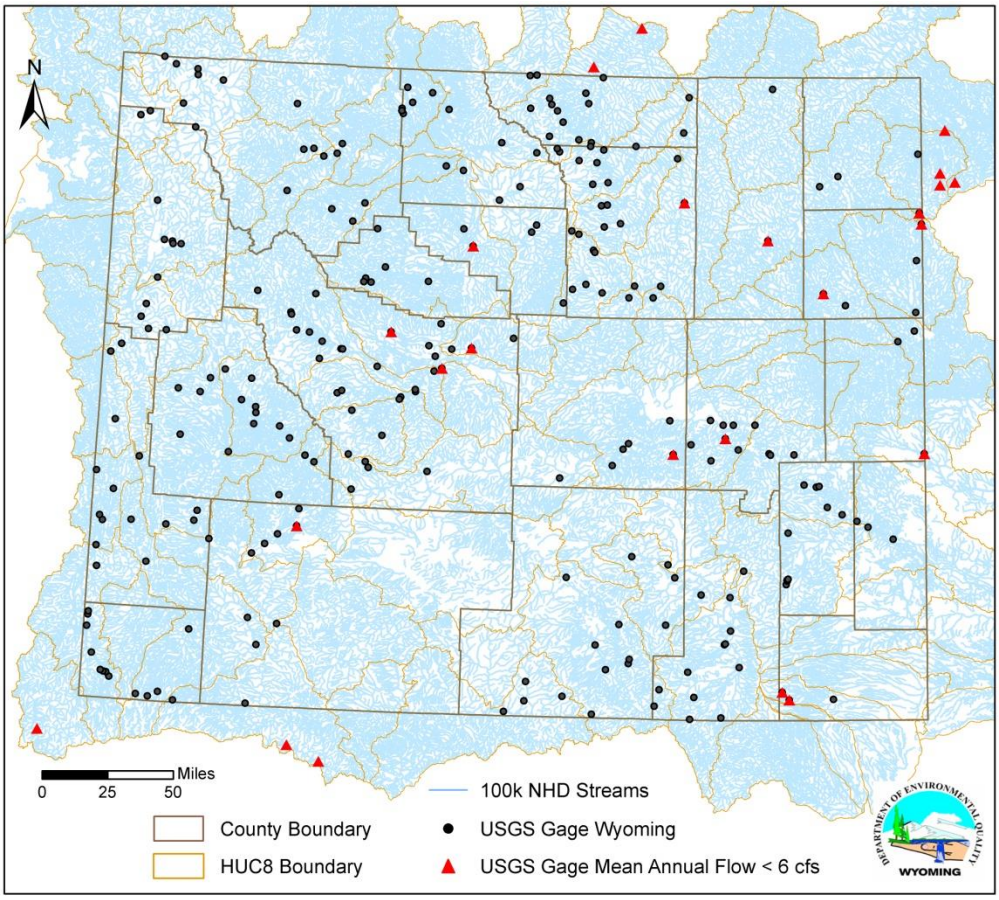

Figure 3. USGS gage sites in Wyoming (257 gages) and adjacent states (9 gages) used in flow analysis.

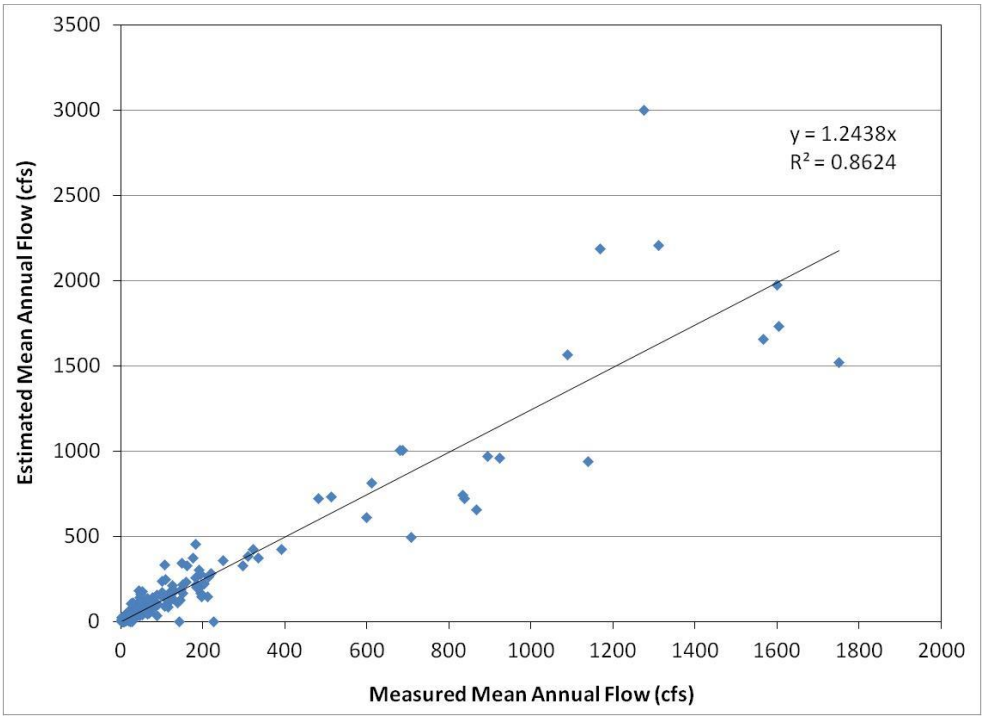

Figure 4. Relationship between measured mean annual flow and NHD*Plus* V2 EROM estimated mean annual flow at 189 USGS gage sites in Wyoming.

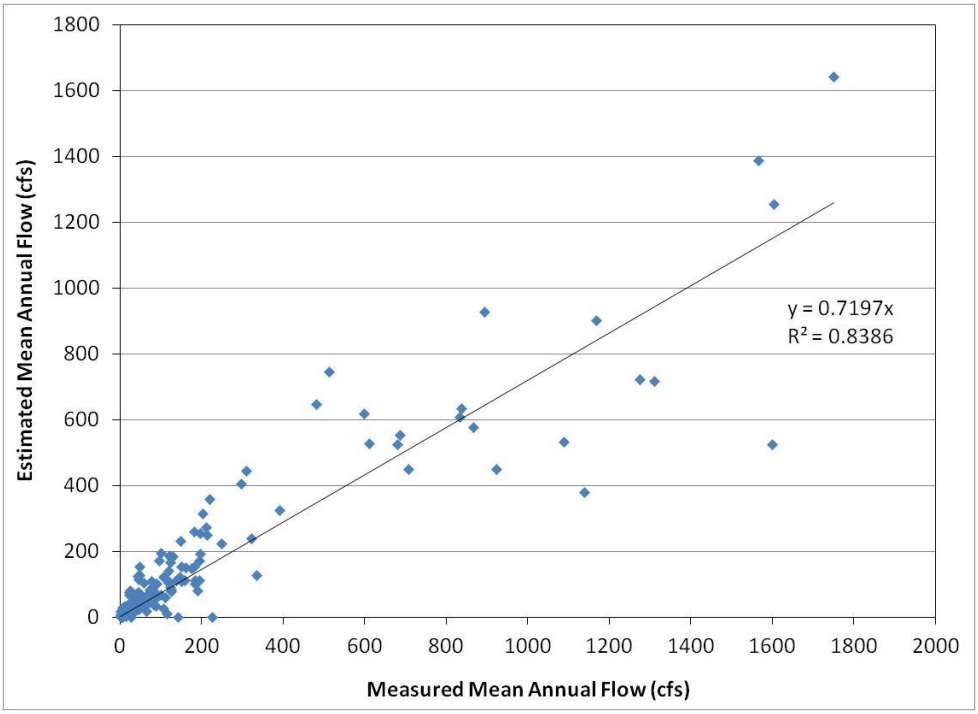

Figure 5. Relationship between measured mean annual flow and NHDPlus V2 Vogel and EROM estimated mean annual flow at 189 USGS gage sites in Wyoming.

above the prevailing water table" (WDEQ/WQD 2013a). Ephemeral streams typically do not have sufficient flow to support full body immersion because they only have water for very short periods immediately following precipitation events. An intermittent stream is a "stream or parts of stream where the channel bottom is above the local water table for some part of the year, but is not a perennial stream" (WDEQ/WQD 2013a). Smaller intermittent streams will generally not have sufficient flow and/or depth to support full body immersion or may naturally dry up or are dewatered for portions of the summer recreation season. A perennial stream is "a stream or part of a stream that flows continually during all of the calendar year as the result of a groundwater discharge or surface runoff" (WDEQ/WQD 2013a). Very small perennial streams (i.e., those that are spring fed, those with very small watersheds, or those that are dewatered during the recreation season) generally lack sufficient flow and/or depth to support full body immersion. Small ditches or those that are dewatered during the summer recreation season also lack sufficient flow and/depth to support full body immersion.

To identify low flow channels that do not have sufficient flow and/or depth to support full body immersion, WDEQ/WQD evaluated the relationship between mean annual flow and mean summer recreation season flow. More than 75% of the total annual streamflow at 257 USGS gage sites in Wyoming occurs during the summer recreation season (May 1 – September 30; Figure 6). Since the majority of the 257 gages are located on larger perennial streams (i.e., channels that are not ephemeral, small intermittent streams, small perennial streams, or small ditches), mean recreation season flows will generally be much higher than mean annual flows for channels that have sufficient flow to support full body immersion ($Q_{REC} > Q_{MAF}$). Conversely, the mean annual flow and mean recreation season flow of stream channels that do not support full body immersion will be more similar ($Q_{REC} \approx Q_{MAF}$) since small perennial streams do not have large enough watersheds to contribute significant runoff during the recreation season; ephemeral streams only flow in response to precipitation events throughout the year; and smaller intermittent streams do not have large enough watersheds to contribute runoff during the recreation season or may be dry for portions of the recreation season.

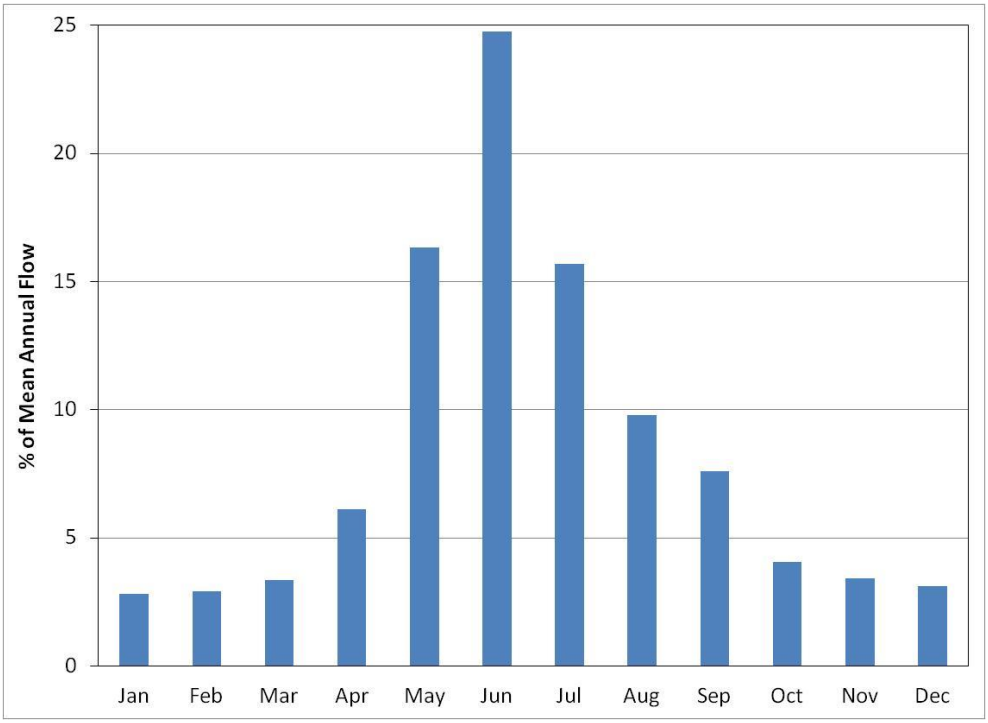

Figure 6. Percentage of mean annual flow by month for 257 USGS gage sites in Wyoming.

Annual hydrographs in a non-drought year, 1996[8], from three USGS gages located in northeast Wyoming show the relationship between mean annual flow and mean recreation season flow for a small perennial stream with a watershed area of 10.0 mi^2 (USGS gage 06392900); an ephemeral stream with a watershed area of 234 mi^2 (USGS gage 06375600); and a perennial stream with a watershed area of 204 mi^2 (USGS gage 06298000) (Figure 7). These gages were identified as perennial and ephemeral in an assessment of low flows in streams in northeast Wyoming (Armentrout and Wilson 1987). As identified in the hydrographs, mean recreation season flow is similar to mean annual flow for the small perennial stream and the ephemeral stream, while mean recreation season flow is much greater than mean annual flow for the larger perennial stream. At the 257 USGS gages in Wyoming, mean recreation season flow was approximately 1.7 times mean annual flow (Figure 8; $R^2 = 0.98$).

For gage sites with the lowest 20% of mean annual flows (51 gages), the relationship was similar; mean recreation season flow was approximately 1.7 times mean annual flow (Figure 9; $R^2 = 0.84$). However, for the 15 gage sites with mean annual flows less than 6 cfs, the relationship between mean annual flow and mean recreation season flow is closer to 1:1 (Figure 9). The period of record for the 15 gages was 10 to 39 years.

To confirm the relationship between mean annual flow and mean recreation season flow for USGS gage sites with mean annual flows less than 6 cfs, WDEQ/WQD determined mean recreation season flow for an additional 9 USGS gages located within adjacent states in HUC8 watersheds that either originate or terminate in Wyoming (Figure 3). The period of record for these gages ranged from 10 to 43 years. For the combined 24 gages, mean recreation season flow was approximately 1.3 times mean annual flow (Figure 10).

Based on this analysis, streams with mean annual flows less than 6 cfs have similar mean recreation season and mean annual flows. Streams with similar mean recreation season and mean annual flows have flow regimes that are typical of channels with insufficient flow to support primary contact recreation (i.e.,

[8] Palmer Drought Severity Index for 1996 was 3.54. http://www.ncdc.noaa.gov/temp-and-precip/ranks.php

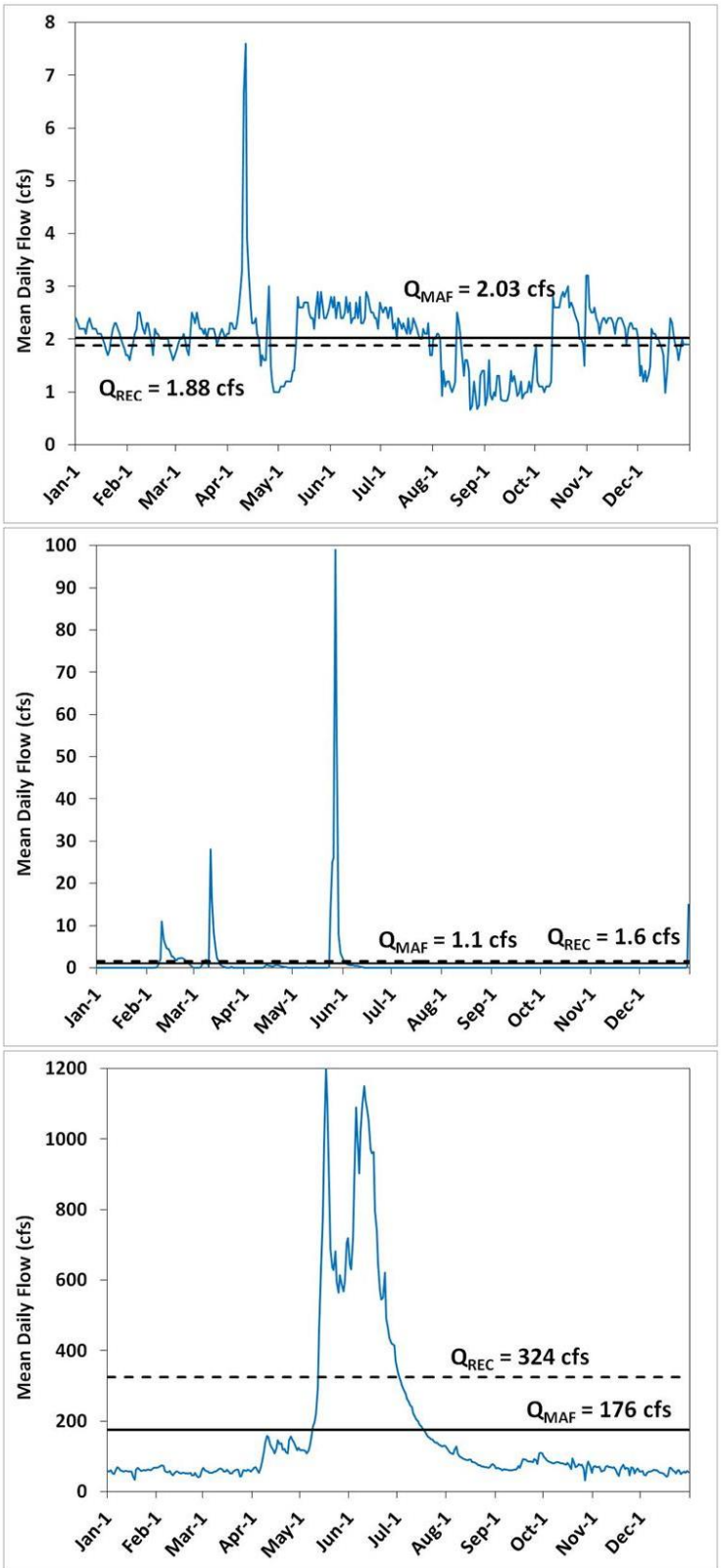

Figure 7. Mean daily flow (blue line), mean annual flow (black line), and mean recreation season flow (dotted line) during 1996 for, from top to bottom, a perennial stream (USGS gage 06392900, watershed area 10 mi^2); an ephemeral stream (USGS gage 06375600, watershed area 234 mi^2); and a perennial stream (USGS gage 06298000, watershed area 204 mi^2).

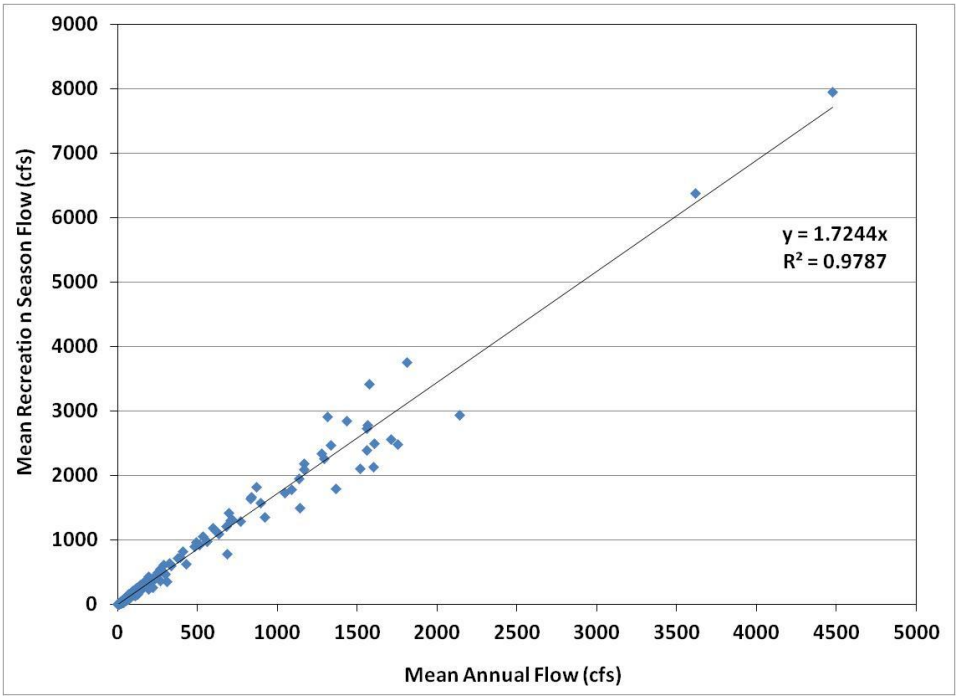

Figure 8. Relationship between mean annual flow and mean recreation season flow for 257 UGSG gages located in Wyoming.

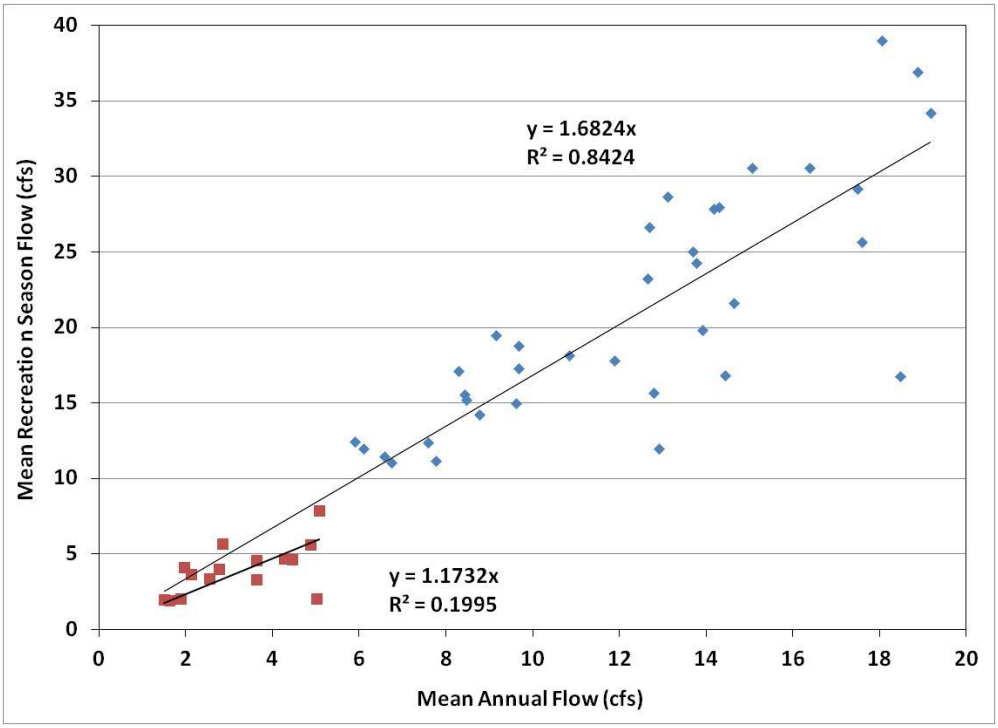

Figure 9. Relationship between mean annual flow and mean recreation season flow for 51 USGS gages located in Wyoming with the lowest 20% of mean annual flows (all points) and the 15 USGS gages with mean annual flows less than 6 cfs (red points).

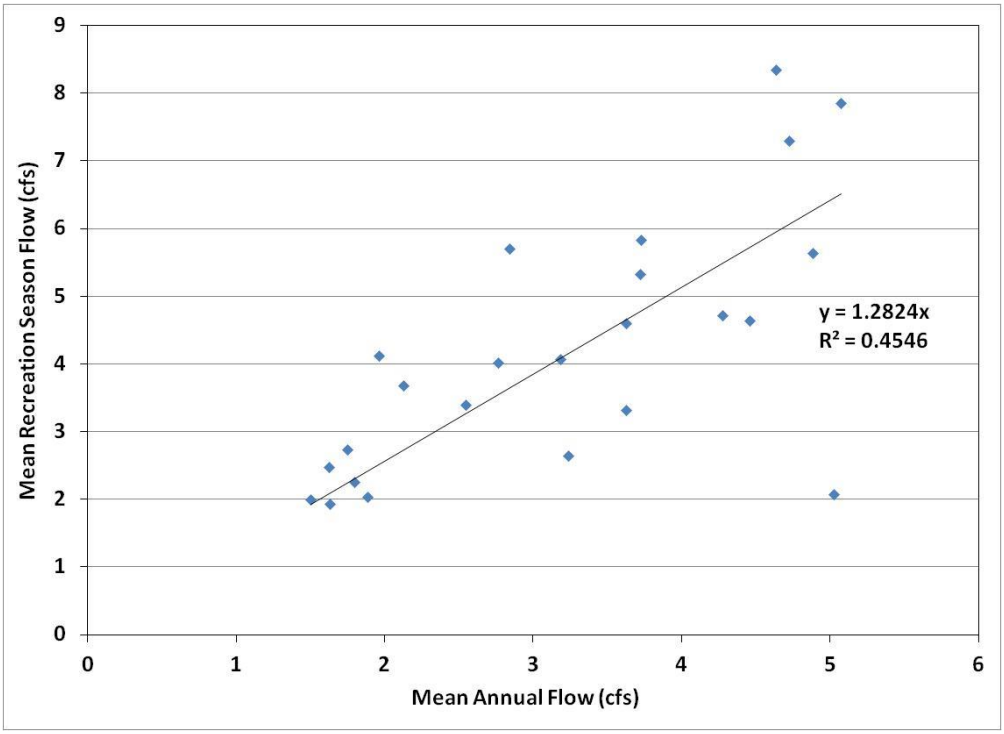

Figure 10. Relationship between mean annual flow and mean recreation season flow for 24 USGS gages located in Wyoming and adjacent HUC8 watersheds with mean annual flows less than 6 cfs.

ephemeral streams, small intermittent streams; small perennial streams and ditches). Therefore, channels with mean annual flows less than 6 cfs do not have sufficient flow to support primary contact recreation unless they are used for water play by small children with a level of contact with the water equivalent to swimming.

It is important to note, however, that while using EROM mean annual flows is appropriate for identifying low flow channels that do not have sufficient flow to support full body immersion at a statewide scale, there are likely channels with mean annual flows of 6 cfs or greater that also do not have sufficient flow to support full body immersion. For these channels, site-specific information should be collected to demonstrate that there is not sufficient flow and/or depth to support full body immersion, even though the EROM mean annual flow is 6 cfs or greater. In addition to demonstrating that there is not sufficient flow and/or depth to support full body immersion, a site-specific UAA would also need to demonstrate that the channel is not used for or likely to be used for child's play with a level of contact with the water equivalent to swimming based on the flow characteristics as well as the accessibility of the channel to small children. When collecting information regarding recreational uses of waters located on or accessed via private property, members of the public should ensure that they have obtained permission from the property owner to both access the property and to collect information.

In addition, the EROM mean annual flow values are modeled estimates. In situations where actual flow measurements indicate that the mean annual flow of a channel is less than 6 cfs, these data can be used to demonstrate that the channel does not have sufficient flow to support primary contact recreation. In circumstances where actual flow measurements were available, either from a USGS gage or from other entities, and showed that the mean annual flow of the channel was less than 6 cfs, the measured mean annual flow was used in the flow analysis. The measured mean annual flow was applied to the flowline segment where the gage was located and also used to extrapolate mean annual flow upstream and downstream of the gaged segment using the proportional EROM mean annual flow estimates. Where a site-specific UAA had been submitted to WDEQ/WQD and sufficiently demonstrated that there was insufficient flow to support full body

immersion, WDEQ/WQD used the qualitative flow information submitted in the UAA to identify those channels as low flow. Site-specific UAAs used to identify a stream as "low flow" in the *Categorical UAA for Recreation* were submitted for portions of Poison Creek, Nowater Creek, East Fork Nowater Creek, Fifteenmile Creek, and Kirby Creek. Portions of the site-specific UAAs used in the analysis are included in Appendix B of the *Categorical Use Attainability Analysis for Recreation Response to Comments for the Comment Period Ending September 30, 2013*.

3.3.3 Validation: Mean Recreation Season Depth of Low Flow Channels

As an additional line of evidence to show that channels with mean annual flows less than 6 cfs do not support full body immersion, WDEQ/WQD evaluated the relationship between mean annual flow and mean recreation season depth at USGS gage sites with mean annual flows less than 6 cfs. Of the 24 gages with mean annual flows less than 6 cfs, 17 gages had USGS field measurement data that could be used to calculate mean cross-sectional depth. USGS field data consists of cross sectional area, stream width, and velocity measurements for some or all of the field discharge values. Mean depth of the channel was calculated using the cross sectional area and channel width for each data point. Flow was plotted with mean depth for each field measurement and a best fit relationship was identified (see Figure 11 as an example).

Mean recreation season depth was then calculated using the best fit relationship and mean recreation season flow at each gage site. For the 17 USGS gage sites with mean annual flows less than 6 cfs, the average mean recreation season depth was 0.5 feet and ranged from 0.4 feet to 0.8 feet (Figure 12). Based on the best fit relationship for all 17 gages, a stream site with a MAF of 6 cfs will have a mean recreation season depth of approximately 0.6 feet. Although the mean recreational season depth information presented here is not representative of an entire channel reach, the depth information does indicate that channels with mean annual flows less than 6 cfs will rarely have median depths at base flow conditions that exceed 1.5 feet. Moreover, based on the shallow depths of the cross sections, it is also unlikely that these channels will have isolated pools with depths greater than 3 feet.

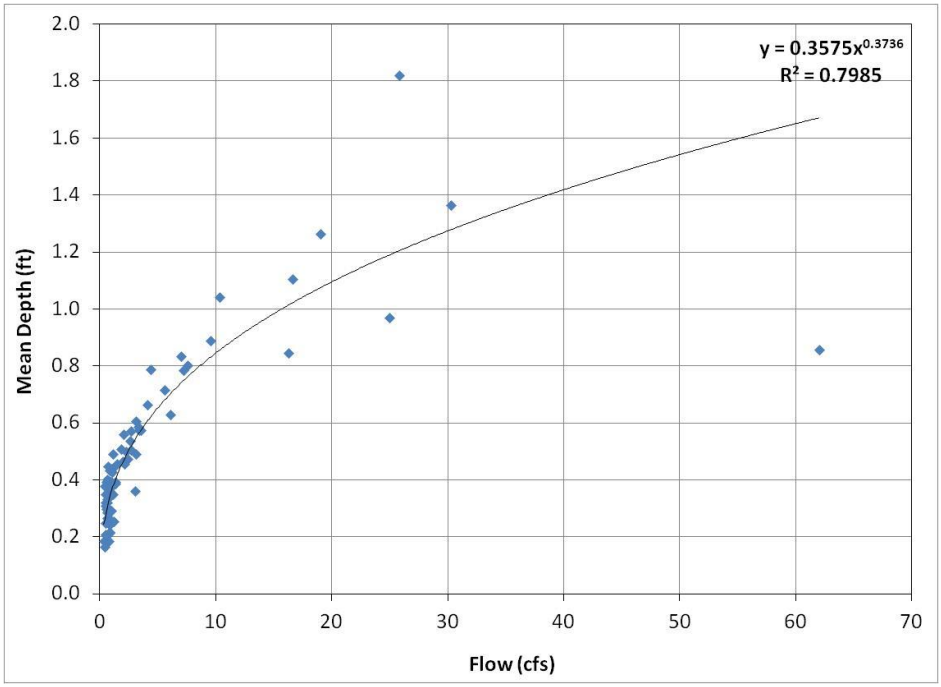

Figure 11. Relationship between flow and mean depth for USGS gage site 06647890 based on field measurement data. Mean depth calculated by dividing cross sectional area by width.

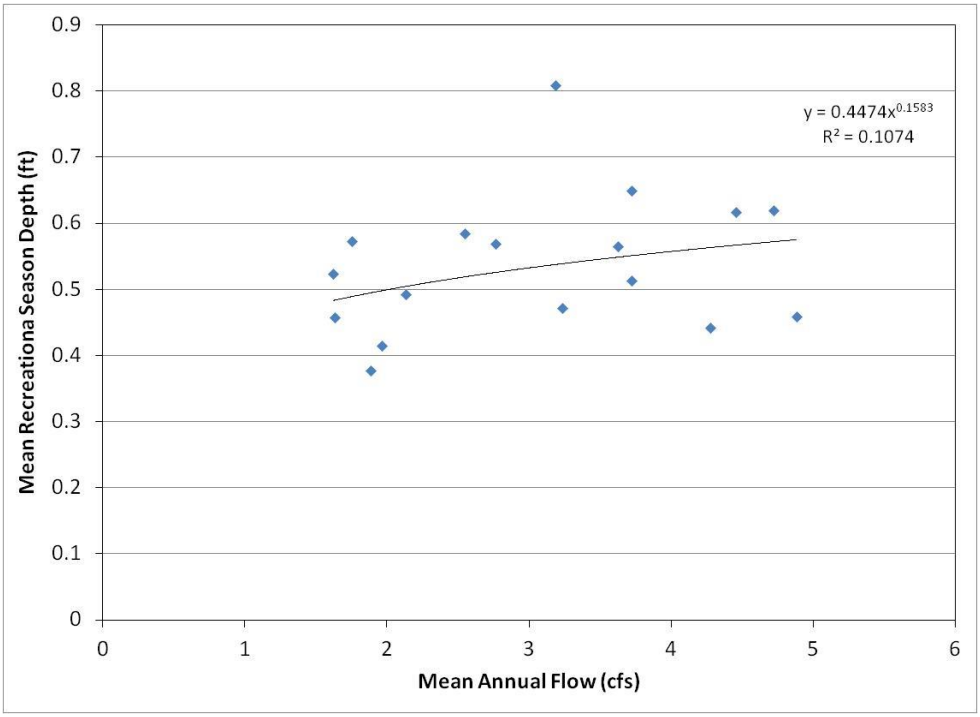

Figure 12. Relationship between mean annual flow and mean recreation season depth at 17 USGS gages with mean annual flows less than 6 cfs.

3.3.4 Validation: Field Surveys

WDEQ/WQD used field surveys conducted by WDEQ/WQD staff and Wyoming's Conservation Districts to validate the results of the Categorical UAA. WDEQ/WQD staff visited 151 sites in July 2010. The sites were selected to focus on public lands and recreational areas and were predominantly located on United States Forest Service Land (75 of 151 sites). Wyoming's Conservation Districts visited 720 randomly generated survey sites between June 28, 2010 and November 3, 2010. Of the 720 sites, 666 (93%) were conducted during the summer recreation season and another 42 surveys were completed during the first week in October. During site visits WDEQ/WQD and Conservation Districts completed field forms (see Appendix C for copies of the surveys), took photographs, and interviewed landowners when possible.

Flows

Since the survey sites visited by Conservation Districts were randomly generated, the surveys were conducted at sites with a range of modeled mean annual flows (Table 1). The answers to the survey questions indicate that the modeled mean annual flow threshold of 6 cfs is appropriate for identifying waters with insufficient flow to support full body immersion (i.e., represented by questions four and five in the Conservation District surveys). Question four, "Is the survey location on a water that is a larger perennial stream or game fishery known to be used by sportsmen or other recreationists?" Question five, "Is the survey location either currently known to be or do you believe that it has a reasonable potential to be used for recreational activities such as fishing, swimming, floating, boating, canoeing, or kayaking?" Of the approximately 439 surveys conducted on sites with mean annual flows less than 6 cfs that were not lakes, there was 97% agreement with Question 4 and 95% agreement with Question 5.

Table 1. Miles of 100k NHD flowlines and locations of Conservation District survey sites by NHDPlus V2 modeled mean annual flows (includes all flowline miles in the state, Class 1, Indian Country).

	NHD Flowlines		Surveys	
	Miles	Percent	Number	Percent
No Flow	10,210	9%	74	11%
> 0 and < 1 cfs	64,281	56%	223	32%
≥ 1 and < 2 cfs	8,678	8%	49	7%
≥ 2 and < 3 cfs	4,551	4%	27	4%
≥ 3 and < 4 cfs	2,900	3%	26	4%
≥ 4 and < 5 cfs	2,254	2%	23	3%
≥ 5 and < 6 cfs	1,685	1%	14	2%
≥ 6 cfs	21,009	18%	264	38%
Total	**115,569**	**100%**	**700**	**100%**

Photos

Photographs of channels of varying orders, mean annual precipitation bands (USDA/NRCS 2006), and mean annual flows are shown below to depict typical channel characteristics of flowlines with mean annual flows less than 6 cfs (Figures 13-25) and greater than or equal to 6 cfs (Figures 26-33). The photographs are shown only to depict channel and flow characteristics; flowlines with mean annual flows less than 6 cfs shown here may not be designated as secondary contact based on the access datasets.

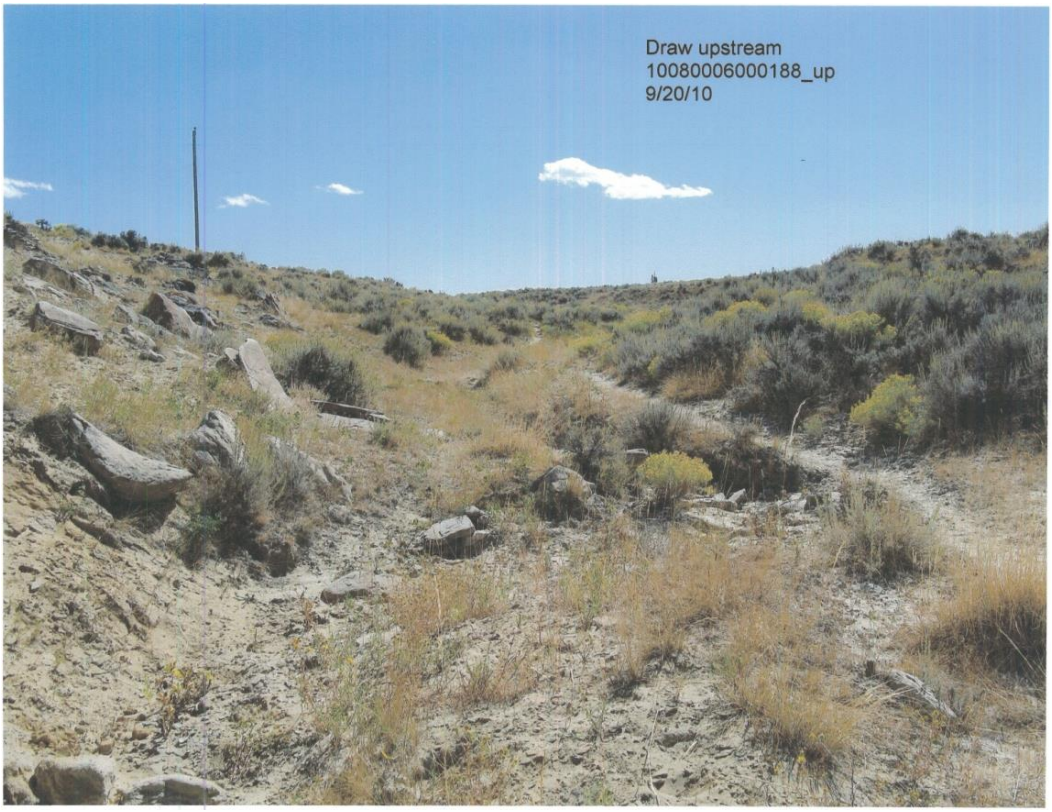

Figure 13. Lower Wind River Conservation District survey point, Unnamed Stream, September 20, 2010. EROM mean annual flow 0.1 cfs, 1st order. Mean annual precipitation 9 inches.

Figure 14. Campbell County Conservation District survey point, tributary to Wild Horse Creek, September 1, 2010. EROM mean annual flow 0.1 cfs, 1st order. Mean annual precipitation 15 inches.

Figure 15. WDEQ/WQD site survey site 17, Cottonwood Creek, July 14, 2010. EROM mean annual flow 0.1 cfs, 1st order. Mean annual precipitation 17 inches.

Figure 16. Campbell County Conservation District survey point, Road Creek, September 22, 2010. EROM mean annual flow 0.2 cfs, 1st order. Mean annual precipitation 15 inches.

Figure 17. WDEQ/WQD survey site 13, Unnamed Creek, July 14, 2010. EROM mean annual flow 0.5 cfs, 2nd order. Mean annual precipitation 19 inches.

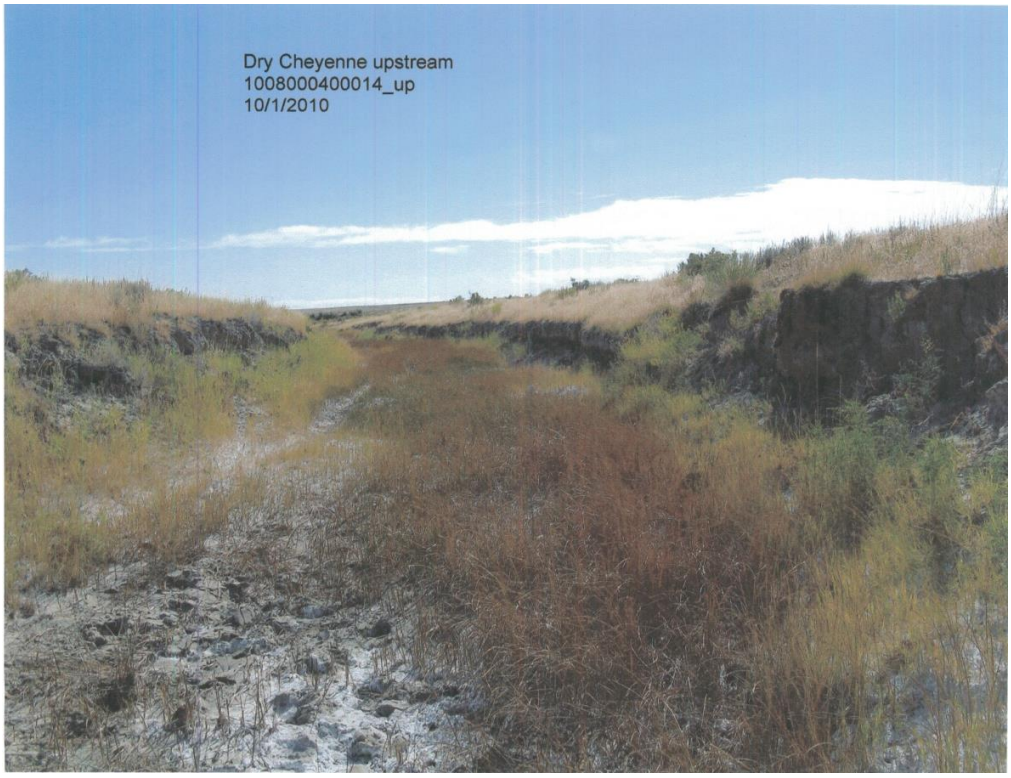

Figure 18. Lower Wind River Conservation District survey site, Dry Cheyenne, October 1, 2010. EROM mean annual flow 1.5 cfs, 3rd order. Mean annual precipitation 7 inches.

Figure 19. Lower Wind River Conservation District survey site, Dry Cheyenne, October 1, 2010. EROM mean annual flow 2.0 cfs, 3rd order. Mean annual precipitation 7 inches.

Figure 20. Goshen County Conservation District survey site, Sheep Creek, September 30, 2010. EROM mean annual flow 2.6 cfs, 3rd order. Mean annual precipitation 15 inches.

Figure 21. WDEQ/WQD survey site 118, Corduroy Creek, July 27, 2010. EROM mean annual flow 2.8 cfs, 1st order. Mean annual precipitation 21 inches.

Figure 22. WDEQ/WQD survey site 115, Grouse Creek, July 26, 2010. EROM mean annual flow 2.8 cfs, 1st order. Mean annual precipitation 21 inches.

Figure 23. WDEQ/WQD survey site 30, Little Willow Creek, July 15, 2010. EROM mean annual flow 2.8 cfs, 1st order. Mean annual precipitation 25 inches.

Figure 24. WDEQ/WQD survey site 66, Red Creek, July 17, 2010. EROM mean annual flow 3.9 cfs, 1st order. Mean annual precipitation 25 inches.

Figure 25. WDEQ/WQD survey site 117, Indian Creek, July 27, 2010. EROM mean annual flow 4.8 cfs, 2nd order. Mean annual precipitation 21 inches.

Figure 26. WDEQ/WQD survey site 93, Beaver Creek, July 19, 2010. EROM mean annual flow 6.0 cfs, 1st order. Mean annual precipitation 17 inches.

Figure 27. WDEQ/WQD survey site 151, South Lodgepole Creek, July 29, 2010. EROM mean annual flow 6.1 cfs, 1st order. Mean annual precipitation 21 inches.

Figure 28. Dubois-Crowheart Conservation District survey site, Tappan Creek, September 17, 2010. EROM mean annual flow 8.5 cfs, 2nd order. Mean annual precipitation 11 inches.

Figure 29. Dubois-Crowheart Conservation District survey site, Whiskey Creek, September 2, 2010. EROM mean annual flow 9.9 cfs, 3rd order. Mean annual precipitation 11 inches.

Figure 30. WDEQ/WQD survey site 10, Beaver Creek, July 13, 2010. EROM mean annual flow 12.5 cfs, 3rd order. Mean annual precipitation 25 inches.

Figure 31. WDEQ/WQD survey site 46, Elk Park Creek, July 16, 2010. EROM mean annual flow 13.6 cfs, 3rd order. Mean annual precipitation 17 inches.

Figure 32. WDEQ/WQD survey site 99, Sawmill Creek, July 19, 2010. EROM mean annual flow 14.0 cfs, 1st order. Mean annual precipitation 25 inches.

Figure 33. WDEQ/WQD survey site 116, La Bonte Creek, July 26, 2010. EROM mean annual flow 14.5 cfs, 3rd order. Mean annual precipitation 21 inches.

3.4 Point Source Discharges

WDEQ/WQD used point source discharge volumes to complete the flow analysis, as Chapter 1, Section 33(b)(ii) and 40 CFR 131.10(g)(2) identify that "natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, *unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges*…" WDEQ/WQD identified channels where full body immersion may be attainable due to point source discharges by adding measured discharge volumes reported by permittees during the 2012 calendar year to the EROM mean annual flow estimates provided in NHDPlus V2 if the discharge point was located within 300 feet of a flowline segment. WDEQ/WQD considered 2012 data representative of current discharge conditions rather than a longer period of record due to reduced production from coal bed methane in recent years. Discharges from coal bed methane are not expected to return in the near future due to low natural gas prices. For outfalls that had multiple measured discharge rates, the reported discharge values were averaged. The addition of WYPDES flow resulted in the addition of approximately 12 flowline miles, although some of these segments would have been identified as primary due to access.

3.5 Mean Annual Flow of Channels Not Present in the 100k NHD

NHDPlus V2 mean annual flow information is only available for flowlines in the 100k NHD. Even though the 100k NHD includes most channels of interest in the state, to avoid situations where a recreational use has not been designated, channels not present in the 100k NHD were also evaluated as part of this UAA. The 100k NHD includes approximately 116,000 flowline miles in Wyoming. The 24k NHD, on the other hand, includes approximately 281,000 flowline miles in Wyoming. The 165,000 additional flowline miles in the 24k NHD are a more detailed representation of channels present in the 100k NHD as well as thousands of miles of ephemeral tributaries to channels depicted in the 100k (see Figure 34 for differences between the 24k and 100k NHD). WDEQ/WQD is also aware of other channels not depicted in either the 100k or 24k NHD.

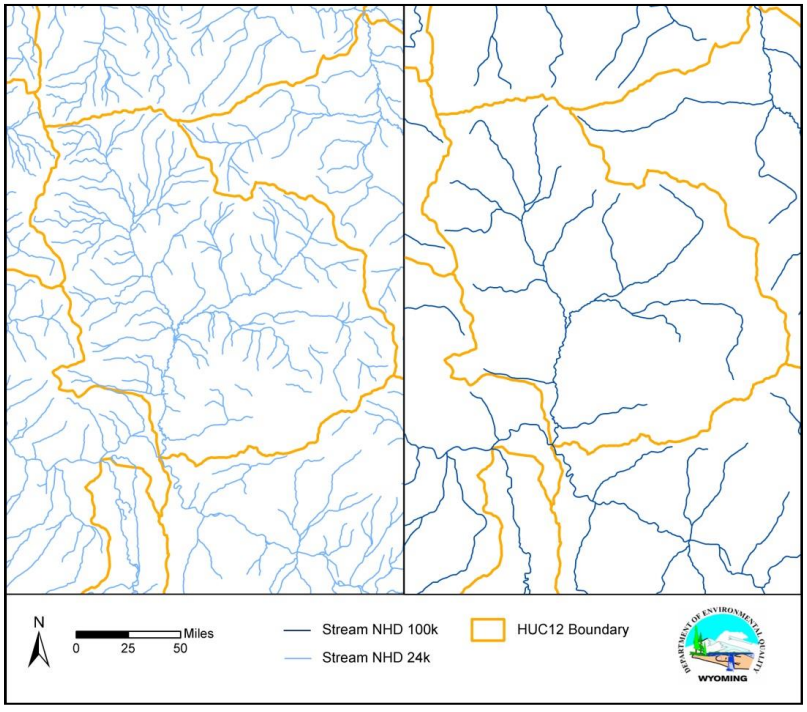

Figure 34. 100k and 24k NHD flowlines present in HUC12 170501020301. Mean annual precipitation 35-41 inches per year (USDA/NRCS 2006).

Watershed area and mean annual flow data from 100k NHD headwater (1st order) flowlines were used to extrapolate watershed area and mean annual flows for channels not present in the 100k NHD. First order flowlines in the 100k NHD have a mean watershed area of 8.6 mi^2, a median watershed area of 1.5 mi^2, and 95th percentile of 7.1 mi^2. First order flowlines in the 100k NHD have an average mean annual flow of 1.1 cfs, a median of 0.2 cfs, and 95th percentile of 4.8 cfs. Since channels not present in the 100k NHD are generally tributaries to 1st order 100k NHD flowlines and because flow and channel size generally increase as you move downstream, channels not present in the 100k NHD will have mean annual flows less than the 6 cfs threshold of channels that do not support full body immersion. As a result, channels not present in the 100k NHD do not have sufficient flow to support full body immersion and will be designated for secondary contact, unless they are located in areas that are easily accessible to small children.

4.0 ACCESS AND RECREATION AREAS

Additional data layers were used to identify flowlines with mean annual flows less than 6 cfs with the greatest likelihood of being used for water play by small children because they are located near towns, schools, parks, and accessible recreation sites. Although low flow channels in these areas generally lack sufficient flow and/or depth to support full body immersion, small children may have a similar level of contact with the water as swimming while playing (i.e., activities of similar duration, intensity, and exposure to the water as swimming) due to the accessibility of these channels. Low flow channels that do not support full body immersion due to low flow conditions that are not located near population centers, schools, parks or recreation sites accessible to small children are designated for secondary contact recreation, as outlined below.

4.1 Demographics of Wyoming

With a population of 563,626 persons based on the April 1, 2010 demographic data from the US Census Bureau, Wyoming is the least populous state in the United States[9] (USCB 2013). This translates to approximately 5.8 persons per square mile, compared to the average U.S. population density of 87.4 persons per square mile. Moreover, since approximately 70% of Wyoming's population lives in towns, large areas of the state are uninhabited. As a result, the majority of ephemeral, small intermittent and small perennial streams and ditches with insufficient flow to support full body immersion are not likely to be used regularly by small children for water play with a level of contact with the water equivalent to swimming because they are not located near population centers, schools, parks or recreation sites.

4.2 Data Layers and Buffers

Populated places, schools, parks, and accessible recreation data layers were derived from multiple sources (Table A-1, Appendix A). Data were downloaded and used directly from a given source, obtained from multiple data sources and combined into one dataset, or generated by WDEQ/WQD. Since various entities frequently update their datasets, the specific datasets used in the UAA should be obtained directly from WDEQ/WQD (see Appendix B for a step by step process of how the UAA was developed).

Datasets and 1.0 mile and 0.5 mile buffers were used to identify geographic areas and 100k NHD flowlines to be excluded from the Categorical UAA based on the likelihood that the channel may be used for water play by small children (Table 2). Primary areas are used to exclude channels not present in the 100k NHD from being designated for secondary contact recreation. Distances used in the analysis are intended to identify those low

[9] United States Census Bureau: http://quickfacts.census.gov/qfd/states/56000.html

flow channels with the greatest likelihood of being used for water play by small children based on a general understanding of how far small children may play from their homes, schools and recreation sites.

Table 2. Datasets and buffer distances used to identify flowlines with the greatest likelihood of being used for child's play in the Categorical UAA for Recreation.

Category	Dataset	Buffer Distance (mi.)
Populated Places and Schools	Census Blocks with Populations Greater than 55 Persons/square mile	1.0
	Schools	1.0
Established Recreation Areas	Campgrounds	0.5
	USFS and BLM Recreation Sites, Natural Areas, and WY DOT Rest Areas	0.5
	National Recreation Areas, Monuments, State Parks and Historic Sites	Within Boundary
Other Accessible Recreation Areas	Trailheads (on public land and within 0.25 miles of a road)	0.5
	Dispersed Campsites (on public land and within 0.25 miles of a road)	0.5

4.2.1 Populated Places and Schools

Populated places and schools were treated similarly because both are frequented by small children. Primary contact recreation was retained on low flow channels located within primary areas and on 100k flowlines located within and 1.0 mile from the boundary of census blocks with 55 persons per square mile or greater and within 1.0 mile from a school. A buffer distance of 1.0 mile was selected based on the distance elementary students are expected to walk to school; elementary schools students are bused if they live more than 1.0 mile from a school based on Wyoming Department of Education Policy (WDE 2002). Since elementary school children are expected to walk up to 1.0 miles to school, WDEQ/WQD anticipates that low flow channels within 1.0 mile from populated places and schools have a higher likelihood of being used for water play by small children with a level of contact with the water equivalent to swimming.

The census block data set (Figure A-1) was derived from the United States Census Bureau 2010 dataset (11,272 polygons). Census blocks with a population density greater than 55 persons per square mile were derived from the 2010 census data by dividing the population by the area of the census block. Population densities greater than 55 persons per square mile were chosen because this density represented the lowest population density of Wyoming's 98 largest municipalities. School locations were derived from a combination of U.S. Department of Education and Wyoming Department of Education references (376 schools; Figure A-2).

4.2.2 Established Recreation Areas

Established recreation areas were identified as campgrounds, United States Forest Service (USFS) and Bureau of Land Management (BLM) recreation sites, natural areas, Wyoming Department of Transportation (WYDOT) Rest Areas, National Recreation Areas, and State Parks and Historic Sites. Primary contact recreation was retained on low flow channels within the boundaries of parks, monuments or historic sites, or within 0.5 miles of other types of established recreation areas, as low flow channels within these areas have a higher likelihood of being used for water play by small children with a level of contact with the water equivalent to swimming.

Campground locations were derived from the Wyoming GeoLibrary (Campgrounds from the USGS Names Database for Wyoming at 1:24,000) and USFS and BLM datasets (397 campgrounds; Figure A-3). Recreation sites were obtained from the USFS and BLM (e.g., picnic areas and boat ramps), Natural Areas from the Wyoming GeoLibrary (Natural Area Tourist Visitation Places for Wyoming at 1:100,000), and Rest Areas from the WYDOT (280 sites; Figure A-4). National Recreation Areas and State Parks and Historic Sites (Figure A-5) were derived from the National Parks Service data store (6 areas; 168,000 acres), and the State Parks, Historical Sites and Trails Department (49 areas; 119,000 acres).

4.2.3 Other Accessible Recreation Areas

Primary contact recreation was also retained on low flow channels within 0.5 miles of a trailheads or a dispersed campsites located on public land and within 0.25 miles of a road (Table 2).

Trailhead locations were derived from USFS and BLM datasets (186 trailheads; Figure A-6). Other trailhead locations within the state (i.e. trailheads in state parks, historic sites, etc.) were not included in the dataset, as channels within these areas were already located in primary areas.

Dispersed campsite data were received from Bighorn, Black Hills, Bridger-Teton, Caribou-Targhee, Medicine Bow, Shoshone, and Uinta-Wasatch-Cache National Forests. In portions of Bighorn, Bridger-Teton, and Shoshone National Forests where data were lacking, WDEQ/WQD personnel collected data directly using GPS surveys (Figure A-7).

Two sources were used to obtain a sufficient roads layer for the state, WYDOT and USFS (Figure A-8). WYDOT highways and county road datasets were combined with USFS roads suitable for passenger cars (USFS categories 3-5), resulting in an approximately 29,000 mile dataset. USFS roads suitable for passenger cars were based on a USFS roads scale of 1-5: basic custodial care (1), high clearance vehicles (2), suitable for passenger cars (3), moderate degree of user comfort (4), and high degree of user comfort (5).

The public lands layer was derived from the BLM GIS data server for Wyoming (Figure A-9). Public land included all lands managed by the National Park Service, National Grasslands, Bureau of Indian Affairs, Fish and Wildlife Service, USFS, State, BLM, Department of Energy, Bureau of Reclamation, Department of Defense, and Corps of Engineers. All other lands were considered private and not included in the analysis.

4.2.4 Wild and Scenic Rivers

Congressionally designated Wild and Scenic Rivers not identified for primary contact recreation through the analysis identified above were retained for primary contact recreation.

4.3 Recreation Use Designations

Channels within primary areas and 100k flowlines where primary contact recreation was retained were those: within or one mile from census blocks with population densities of 55 persons per square mile or greater; within one mile of a school; within 0.5 miles of established campgrounds, USFS recreation sites, Natural Areas, and WYDOT Rest Areas; within National Recreation Areas, and State Parks and Historic Sites. Other channels where primary contact recreation was retained were within 0.5 miles of trailheads and dispersed campsites that were located on public land and within the 0.25 mile buffer for roads (Figure 35).

5.0 EXTENSIONS

To help eliminate isolated primary flowlines, two primary segments separated by an isolated secondary segment were extended to include the isolated secondary segment. Side channels of braided primary flowlines were also retained as primary.

6.0 RESULTS

Based on this analysis, approximately 89,060 of the 104,145 100k NHD flowline miles addressed in this UAA do not have sufficient flow to support full body immersion (Table 3, Figure 36). Of these 89,060 flowline miles, approximately 4,949 miles occur in areas easily accessible to small children due to their proximity to schools, towns and recreation areas. Although these channels will generally not support full body immersion, because children may play in the water with a level of contact with the water equivalent to swimming, primary contact recreation has been retained. An additional 4 flowline miles of congressionally designated Wild and Scenic Rivers were retained for primary contact recreation and 1,210 flowline miles were retained for primary contact recreation through the extension process to eliminate isolated secondary flowline segments. When combined, approximately 82,896 of the 104,145 100k NHD flowlines addressed in this UAA, 79.6% of the flowlines, do not have sufficient flow to support full body immersion, are not congressionally designated Wild and Scenic Rivers, and are not located in areas that are easily accessible to small children. These 82,896 flowlines miles represent channels where primary contact recreation is not an existing or attainable use (Figure 37). Because primary contact recreation is not an existing or attainable use on these 82,896 flowline miles, the primary contact recreation use can be removed and these flowlines can be designated for secondary contact recreation.

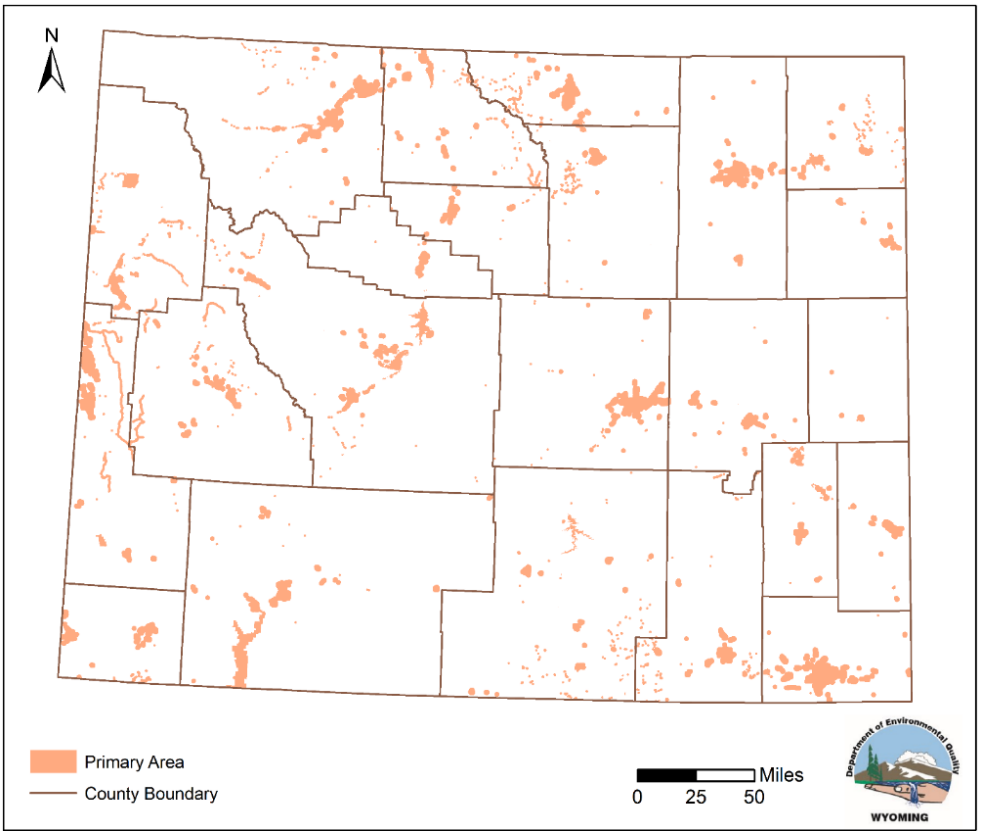

Figure 35. Areas of Wyoming where channels not present in the 100k NHD are designated for primary contact recreation.

Table 3. Categories of NHD 100k flowline miles and percentages assigned by Categorical UAA.

UAA Category	Miles	Percent of Flowlines
Total 100k NHD Flowlines	104,145	100.0
Primary Due to Flow (Including WYPDES)	15,085	14.5
Insufficient Flow to Support Full Body Immersion	89,060	85.5
Primary Due to Access	4,949	4.8
Primary Due to Extensions	1,210	1.2
Primary Due to Wild and Scenic	4	0.0
Total Primary Flowlines	21,249	20.4
Total Secondary Flowlines	82,896	79.6

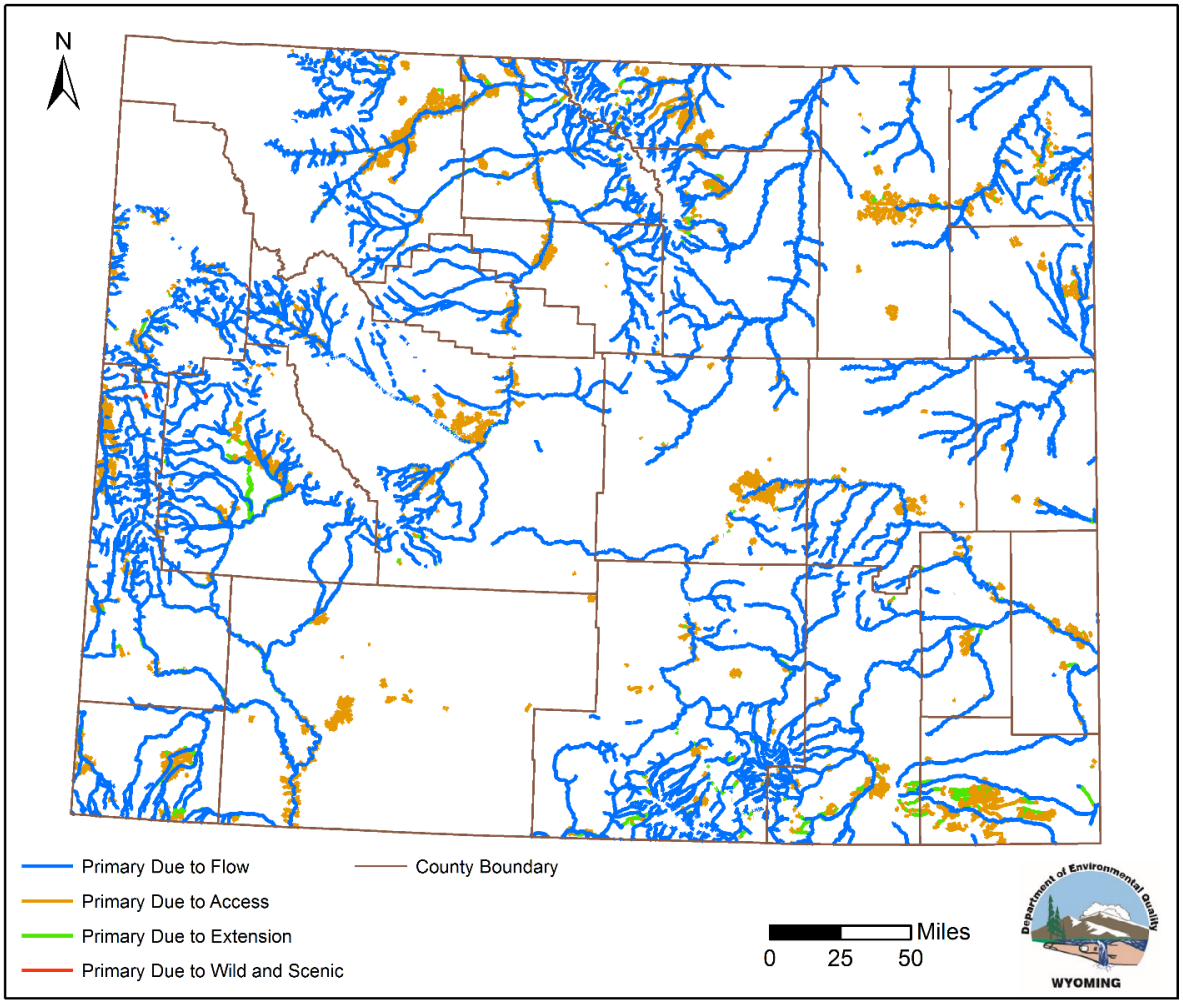

Figure 36. Primary recreation 100k flowlines based on flow, access, and extensions.

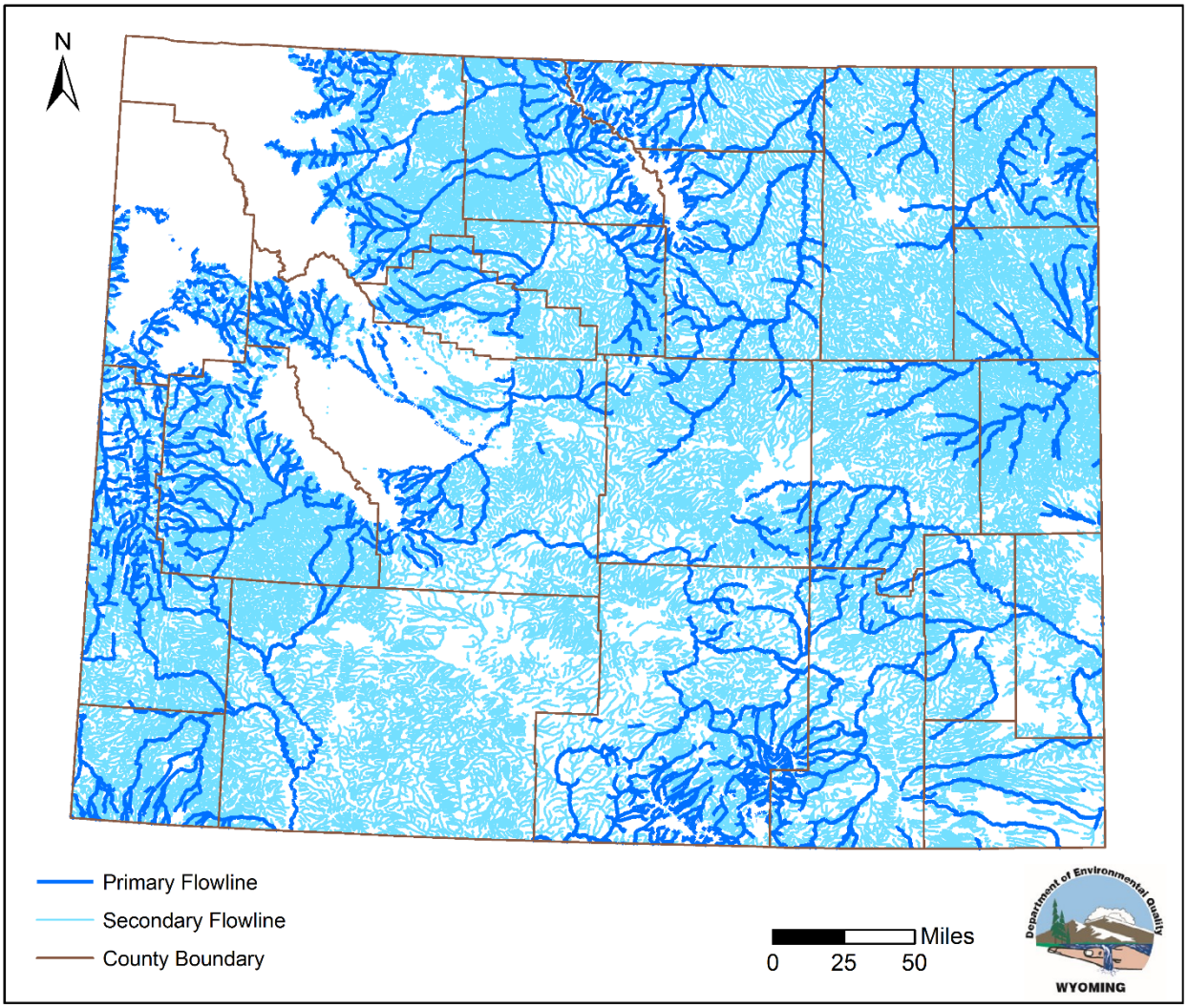

Figure 37. Primary and secondary contact recreation designations based on the Categorical UAA for Recreation.

6.1 Surveys

WDEQ/WQD and Wyoming's Conservation Districts conducted field surveys at 871 sites during 2010 to validate the results of the *Categorical UAA for Recreation* (Figure 38). WDEQ/WQD conducted a total of 151 surveys in July 2010 on segments primarily located on public lands and recreational areas, with the majority (75 of 151 sites) located on lands managed by the USFS (See Appendix C, Figure C-1 for survey). The Wyoming Association of Conservation Districts (WACD) facilitated the collection of 720 surveys by Conservation Districts between June 28, 2010 and November 3, 2010 from 1,000 randomly generated survey points (see Figure C-2 for survey).

The percentage of surveys conducted on lands of various ownership and/or land management represented the proportion of land ownership/management in Wyoming very well. Conservation Districts surveyed approximately 310 sites on lands managed by the BLM and USFS (approximately 43% of the surveys completed). Within Wyoming, BLM and USFS lands represent approximately 42% of the land area. Conservation Districts surveyed approximately 334 sites on private land (44% of the surveys) and

approximately 46% of the land area in Wyoming is private. Conservation Districts surveyed approximately 46 sites (6% of the surveys) on state land and approximately 6% of the land area in Wyoming is state land.

WDEQ/WQD identified 101 of the 151 sites as primary and 50 sites as secondary (Table 4). Prior to and after the extension process, 5 of the 101 sites identified as primary in the field were designated as secondary by the UAA, resulting in 95% agreement between the UAA and the WDEQ/WQD primary surveys.

The WACD surveys identified 250 of 720 sites as primary and 470 as secondary. Prior to the extension process, 18 of the 250 sites identified as primary in the field were designated as secondary by the UAA, resulting in 92.8% agreement between the UAA and the primary surveys. After the extension process, only 13 of the 250 sites identified as primary in the field were designated as secondary by the UAA, resulting in 94.8% agreement between the UAA and the WACD primary surveys.

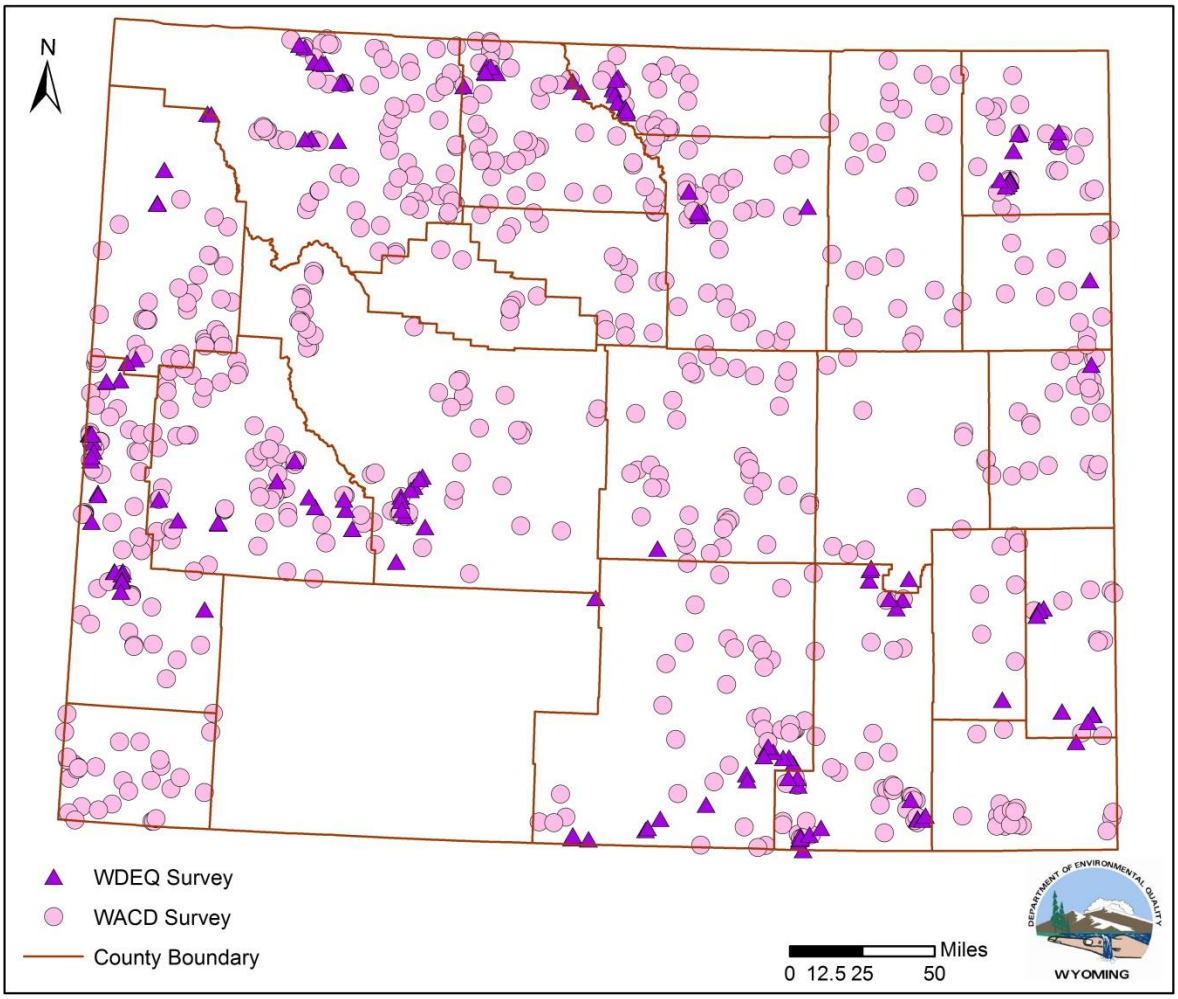

Figure 38. WDEQ/WQD and WACD survey sites. All points are not visible due to overlapping sites.

Overall, prior to extensions, the WDEQ/WQD surveys had 76.2% agreement with the UAA, while the WACD surveys had 81.5% agreement with the UAA. The results went down slightly for each of the surveys after the extension process; there was 74.8% agreement between the WDEQ/WQD surveys and the UAA and 80.7% agreement between the WACD surveys and the UAA. After combining the two sets of surveys, agreement between the primary surveys was very good, 93.4% before extensions and 94.9% after extensions. Likewise,

overall agreement between the two sets of surveys and the UAA was very good; 80.6% before extensions and 79.7% after extensions.

Table 4. Number and percentage of WDEQ/WQD, WACD field surveys in agreement with the UAA before and after extensions.

	WDEQ/WQD Surveys		WACD Surveys		All Surveys	
	No.	%	No.	%	No.	%
Primary Before Extensions	96 of 101	95.0	232 of 250	92.8	328 of 351	93.4
Primary After Extensions	96 of 101	95.0	237 of 250	94.8	333 of 351	94.9
Overall Before Extensions	115 of 151	76.2	587 of 720	81.5	702 of 871	80.6
Overall After Extensions	113 of 151	74.8	581 of 720	81.0	694 of 871	79.7

7.0 CONCLUSIONS

The *Categorical UAA for Recreation* used the best information available at a state-wide scale to identify waters where primary contact recreation is not an existing or attainable use. Because the UAA was conducted at a state-wide scale, WDEQ/WQD recognizes that the UAA will not designate the recreational use of all channels of the state correctly. However, after public feedback was incorporated into the UAA, there should be very few instances where a channel is used for or supports primary contact recreation, yet is designated as secondary by the UAA. A much more common occurrence will be channels that do not support primary contact recreation, particularly due to insufficient flow, that are designated as primary. In this circumstance, site-specific UAAs can be used to remove the primary contact recreation use by providing information to demonstrate that there is insufficient flow to support full body immersion and that the channel is not regularly used for water play by small children with a level of contact with the water equivalent to swimming. For site-specific UAAs based on the "low flow" factor, information such as mean depth or mean annual flow should be collected to show that the channel does not support full body immersion. WDEQ/WQD recommends contacting the department in circumstances where designated uses are not reflective of existing or attainable uses. When collecting information regarding recreational uses of waters located on or accessed via private property, ensure that permission has been obtained from the property owner to both access the property and to collect information that may be submitted to WDEQ/WQD.

WDEQ/WQD also recognizes that recreational uses will change over time. Information indicating that a channel designated for secondary contact recreation is used for primary contact recreation will be cause for WDEQ/WQD to change the recreation designated use to primary contact. Further, WDEQ/WQD may update the *Categorical UAA for Recreation* through the formal UAA process as new data and information become available; individuals or entities interested in modifying a recreational use designation for a particular waterbody should contact WDEQ/WQD.

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LP/rm/16-0795

APPENDIX A. DATA SOURCES AND MAPS

Table A-1. Data layers and sources of data used in the categorical UAA for recreation. Sources without hyperlinks were obtained directly from the source. The data presented at these sites may not be identical to those used in the UAA as various entities update their information. For original datasets, contact WDEQ/WQD.

LAYER	SOURCE
Flowlines	National Hydrography Dataset (USGS; 1:100,000)
Mean Annual Flow	NHDPlus Version 2
WYPDES Flow	WYPDES Database
Municipalities/Populated Areas	US Census Bureau 2010 Data
Schools	U.S. Department of Education
	Wyoming Department of Education
National Park Service Areas, State Parks and Historic Sites	National Park Service
	Wyoming State Parks (State Parks and Historic Sites)
Campgrounds	Wyoming Geolibrary (Campgrounds from the USGS Names Database for Wyoming at 1:24,000)
	USFS Region 2 Campgrounds
	USFS Region 4 Campgrounds
	BLM Field Offices
USFS Recreation Sites, Natural Areas, WYDOT Rest Areas	USFS Region 2 Recreation Sites
	USFS Region 4 Recreation Sites
	Wyoming Geolibrary (Natural Area Tourist Visitation Places for Wyoming at 1:100,000)
	Wyoming Department of Transportation
	BLM Field Offices
Trailheads	USFS Region 2 Trailheads
	USFS Region 4 Trailheads
	BLM Field Offices
Dispersed Campsites	Bighorn, Black Hills, Bridger-Teton, Caribou-Targhee, Medicine Bow, Shoshone, and Uinta National Forests
	BLM Field Offices
	WDEQ Direct Observation (Portions of Shoshone, Bighorn and Bridger-Teton National Forests)
Roads	WYDOT Highways, WYDOT County Roads
	USFS Region 2 Roads (Categories 3, 4, and 5)
	USFS Region 4 Roads (Categories 3, 4, and 5)
Public Land	Bureau of Land Management
Wild and Scenic Rivers	WDEQ and National Wild and Scenic Rivers System
Class 1 Waters	WDEQ and Wilderness.Net
Indian Country Boundary	State of Wyoming

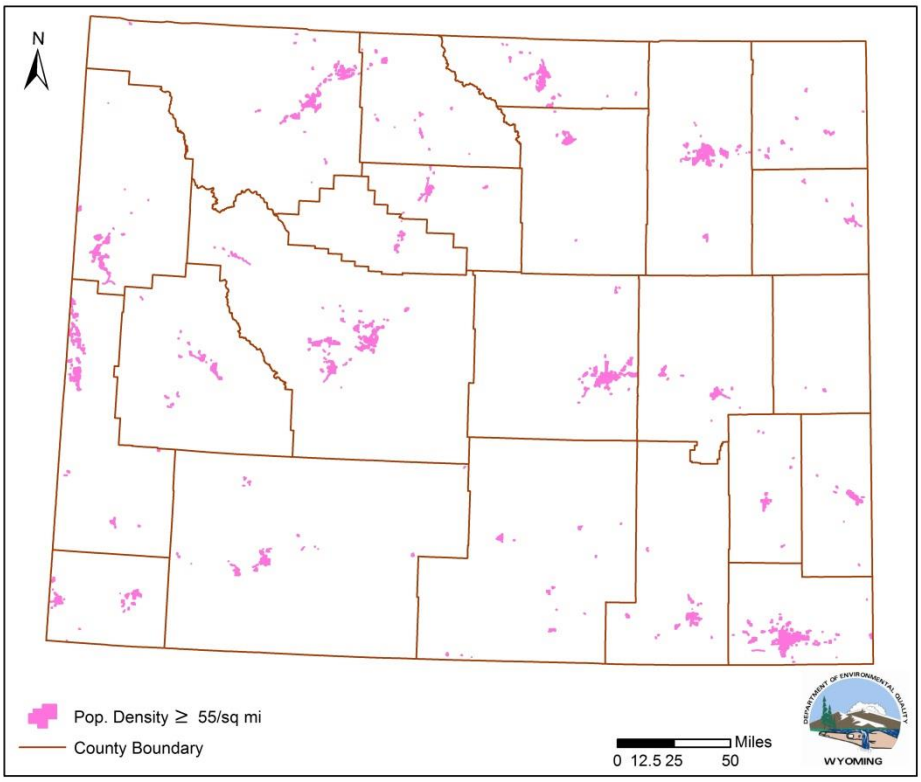

Figure A-1. Populated places (2010 US Census density ≥ 55 person per square mile) used in the Categorical UAA for Recreation.

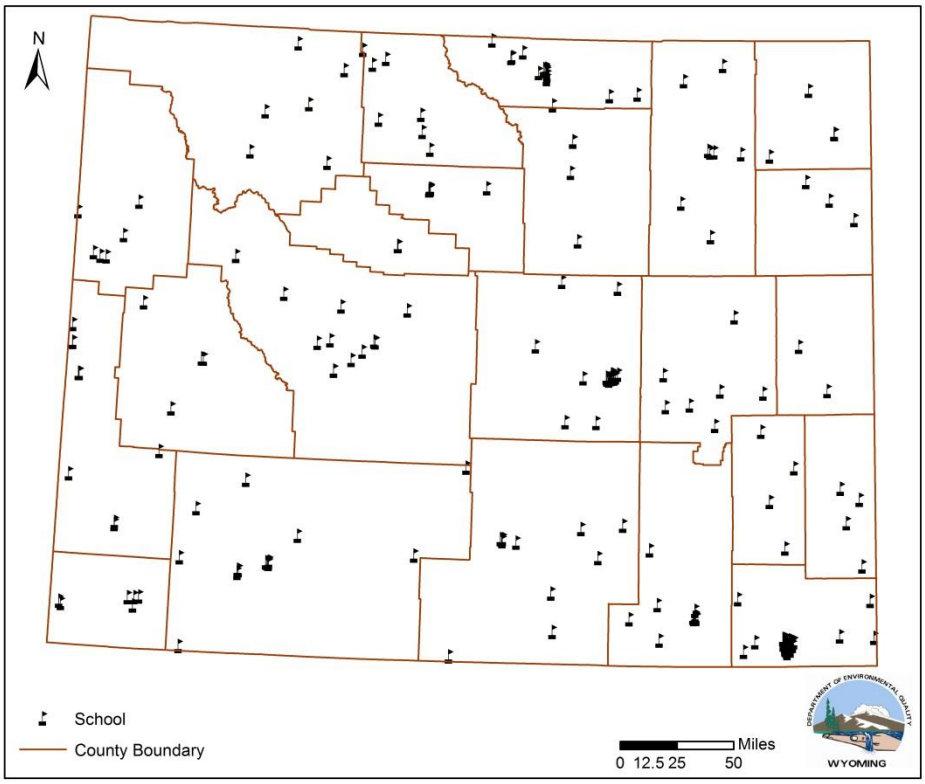

Figure A-2. School locations used in the Categorical UAA for Recreation.

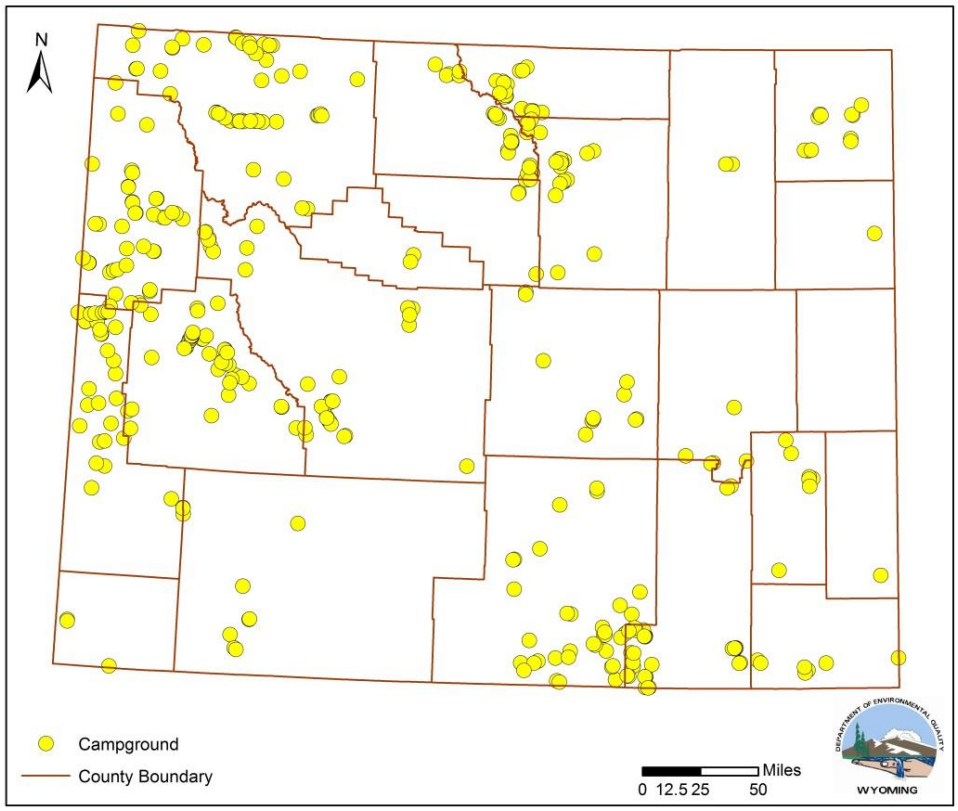

Figure A-3. Developed campground locations used in the Categorical UAA for Recreation.

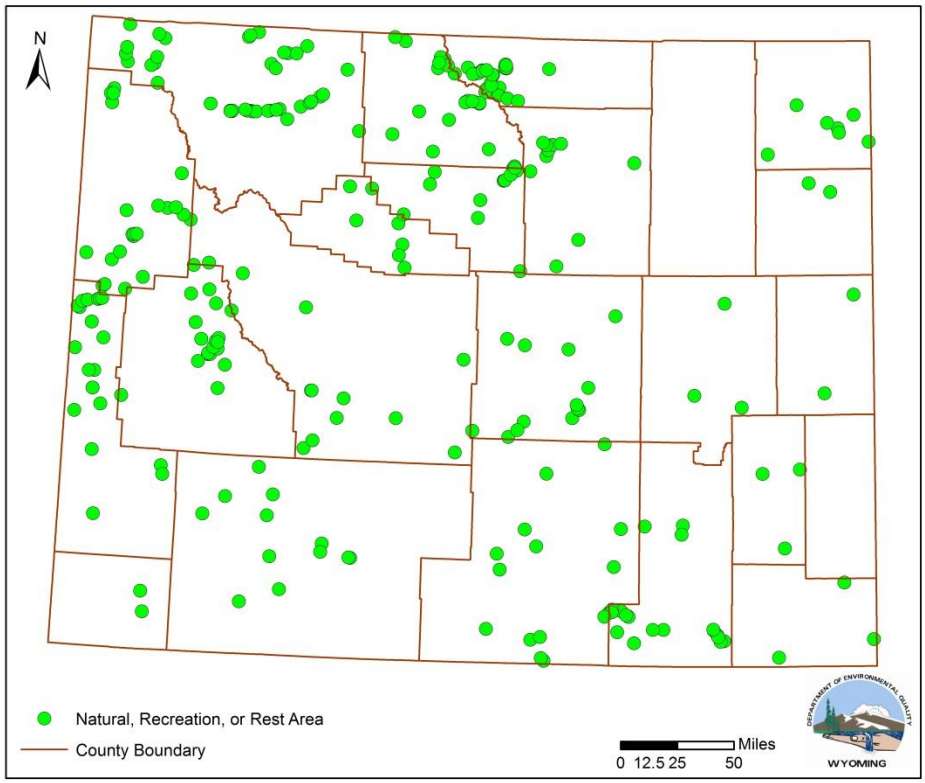

Figure A-4. United States Forest Service (USFS) and Bureau of Land Management (BLM) recreation sites, Natural Areas, and Wyoming Department of Transportation (WYDOT) rest areas used in the Categorical UAA for Recreation.

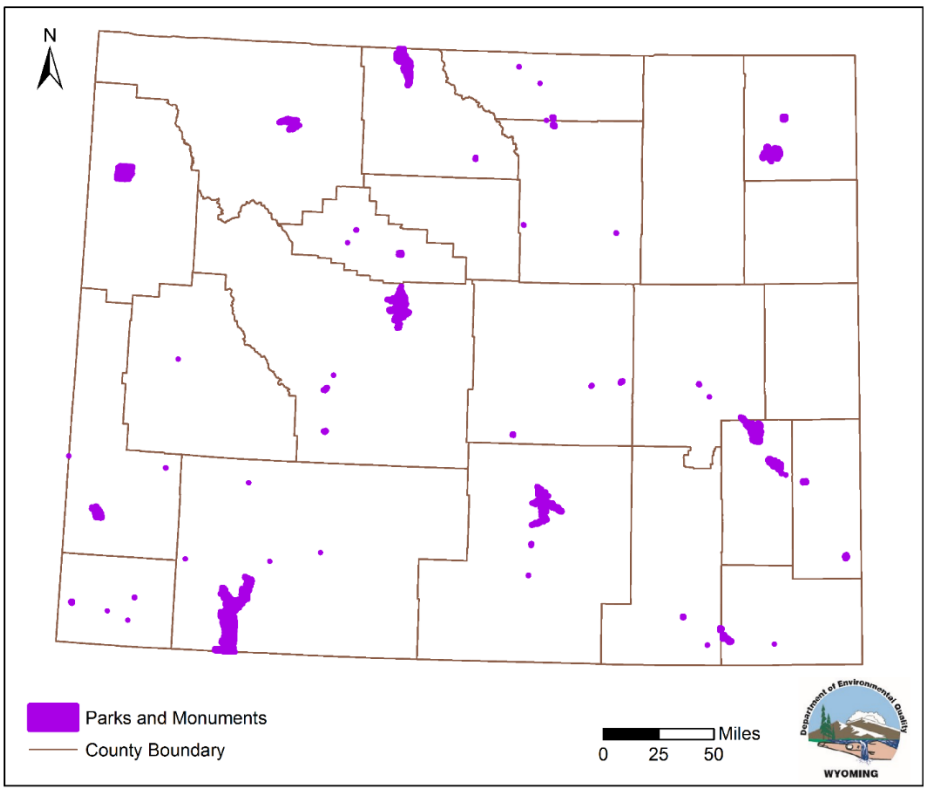

Figure A-5. National Recreation Areas, State Parks and Historic Sites used in the Categorical UAA for Recreation.

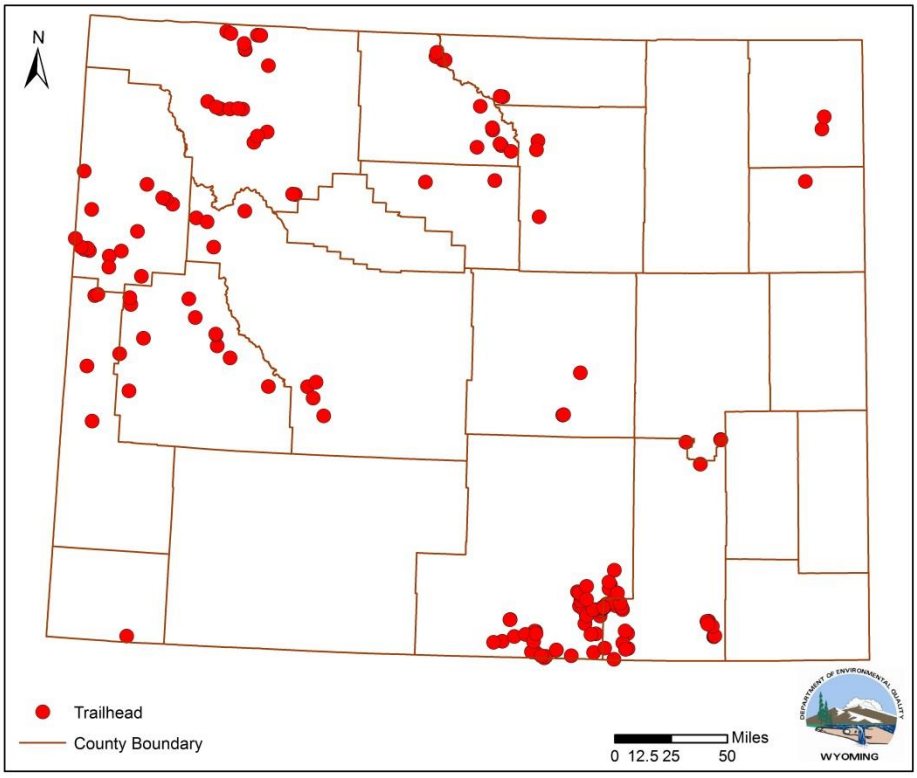

Figure A-6. Trailheads dataset used in the Categorical UAA for Recreation.

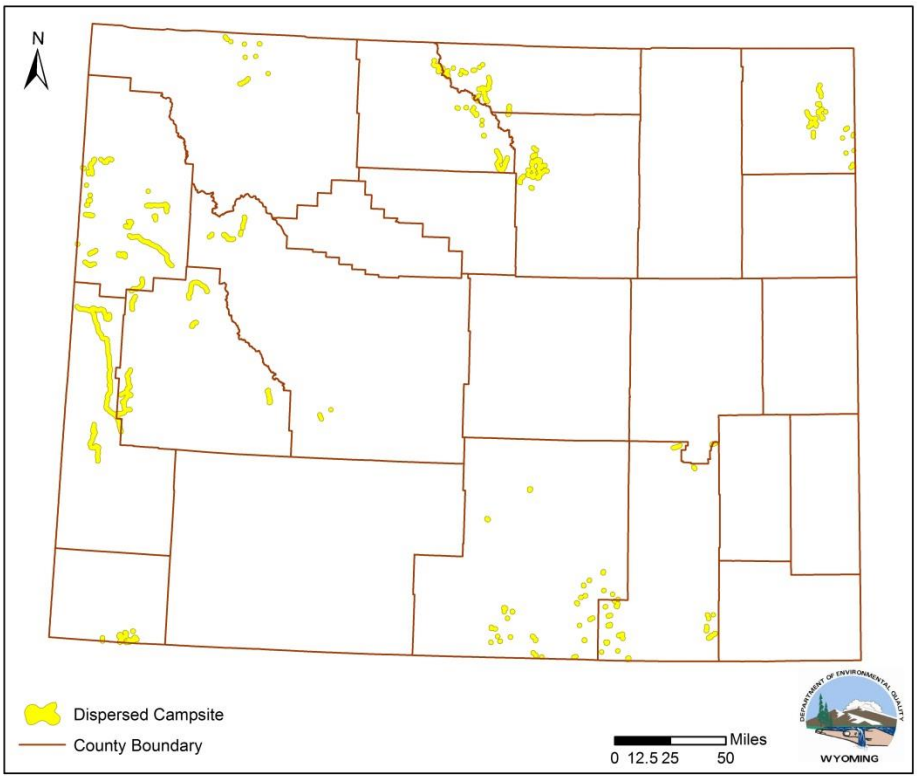

Figure A-7. Dispersed campsite dataset used in the Categorical UAA for Recreation.

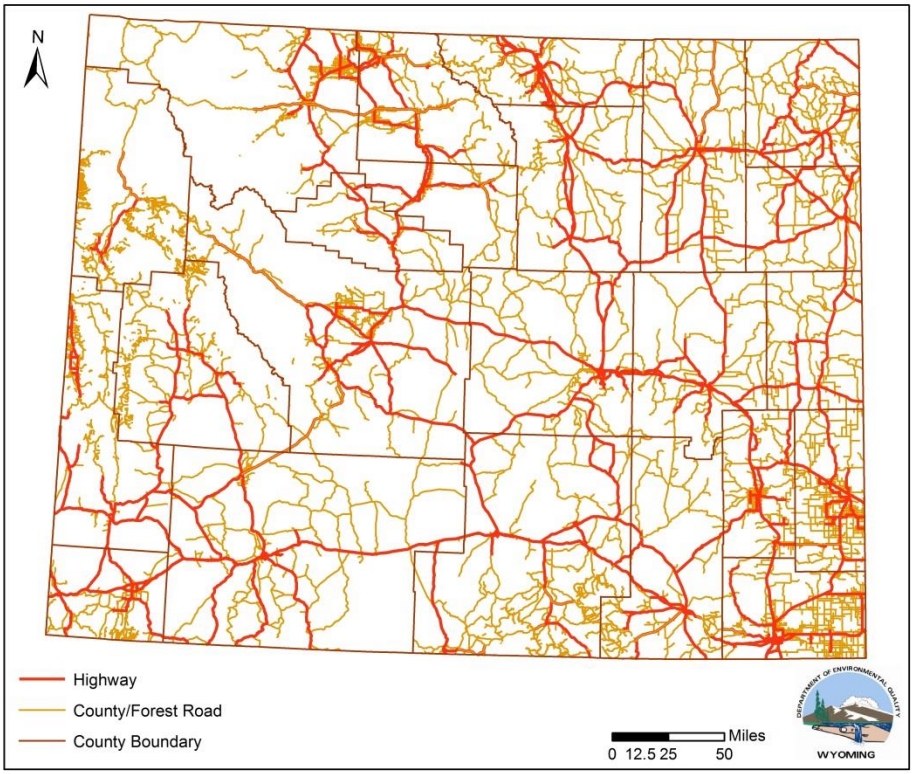

Figure A-8. Roads dataset used in the Categorical UAA for Recreation.

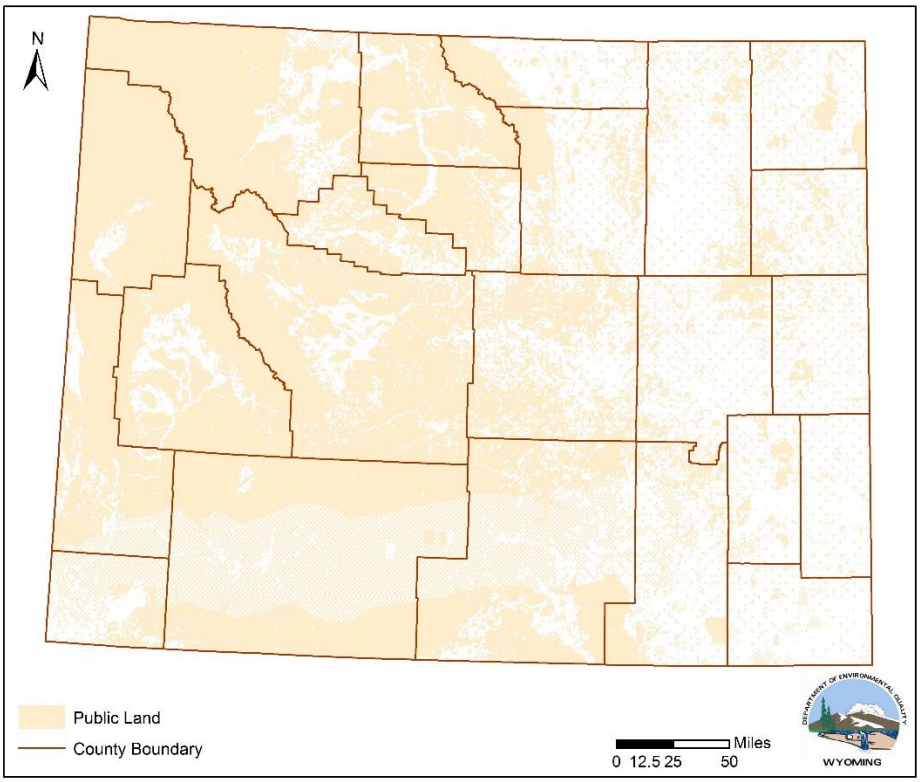

Figure A-9. Public land dataset used in the Categorical UAA for Recreation.

APPENDIX B. MODEL STEPS

1. Create new map document (mxd) in ArcMap. Add polygon file of Wyoming. From NHDPlus, version 2, download NHD Snapshot and data files for all five basins found in WY. (http://www.horizon-systems.com/NHDPlus/NHDPlusV2_data.php). Add NHD Flowline and NHD Waterbodies from all five basins to mxd. Merge all five NHD Flowline files into one file and merge all five NHD Waterbody files into one file. Clip each of the new files to Wyoming state boundaries. Continue to work with Flowline file.

2. Add new field, 'NHD Flow' to the Flowline attribute table. Join flow data from NHDPlus data file downloaded in step one to the 'NHD Flow' field. Add two new fields, 'MeasFlow' and 'ObsCond.' Join any site-specific flow data from USGS gaging stations or measured flow to 'MeasFlow' field; and observed flow conditions to 'ObsCond' field. Add new field, 'WYPDES_Fl.' Add WYDES average discharge for 2012 (for discharge within 300 feet of 100k flowine) (F:\Division\WQD\WYPDES Business Views). Add new field, 'TotFlow,' and calculate total flow by adding 'WYPDES_Fl' to 'MeasFlow' or 'NHD_Flow.' Split file into two files, one with flow ≥ 6cfs ('Primary Due to Flow') and one with flow < 6cfs ('Low Flow'). Keep 'Primary Due to Flow' file as is. Continue to work with the 'Low Flow' file.

3. Add Census Blocks (https://www.census.gov/geo/maps-data/data/tiger.html) file to mxd. Add new field, 'Area_SqMi.' Calculate area in square miles using Calculate Geometry. Add new field, 'Pop_Dens.' Calculate population density per square mile using Field Calculator. Select density ≥ 55 people per square mile and create new file. Create buffer around new file at 1 mile. Clip and erase 'Low Flow' file using buffer. Add 'PopDens' field to 'Low Flow' attribute table. For 'Low Flow' segments intersecting buffer, assign 'Yes' to attribute table (used to denote primary contact recreational use). Merge back into one file.

4. Add School locations (US Dept. of Education: http://nces.ed.gov/surveys/sdds/ed/index.asp, WY Dept. of Education: fusion.edu.wyoming.gov/MySites/Director) to mxd. Verify locations of rural schools using Google Earth. Create buffer at 1 mile. Clip and erase 'Low Flow' file using buffer. Add 'School' field to 'Low Flow' attribute table. For 'Low Flow' segments intersecting buffer, assign 'Yes' to attribute table. Merge back into one file.

5. Add campgrounds (Wyoming GeoLibrary: http://piney.wygisc.uwyo.edu/data/recreation/Campgrounds_USGS.zip, USFS campgrounds: http://www.fs.usda.gov/main/r2/landmanagement/gis, http://www.fs.usda.gov/main/r4/landmanagement/gis, individual BLM field office campgrounds) to mxd. Create buffer around campgrounds at 0.5 miles. Clip and erase 'Low Flow' file using buffer. Add 'Campground' field to 'Low Flow' attribute table. For 'Low Flow' segments intersecting buffer, assign 'Yes' to attribute table. Merge back into one file.

6. Add Natural Areas, Recreation Sites, and Rest Areas (http://piney.wygisc.uwyo.edu/data/recreation/natural_areas.zip, USFS recreation sites, Wyoming Department of Transportation rest areas, BLM recreation sites) to mxd. Create buffer around locations at 0.5 miles. Clip and erase 'Low Flow' file using buffer. Add 'NatRecArea' field to 'Low Flow' attribute table. For 'Low Flow' segments intersecting buffer, assign 'Yes' to attribute table. Merge back into one file.

7. Add National Recreation Areas, Monuments and State Parks and Historic Sites (nrdata.nps.gov for National Recreation Areas and Monuments; State Park files supplied by Wyoming State Parks, Historic Sites) to mxd. Merge into one file. Clip and erase 'Low Flow' file for boundary. Add 'Parks' field to 'Low Flow' attribute table. For 'Low Flow' segments within boundary, assign 'Yes' to attribute table. Merge back into one file.

8. Add Roads (WDEQ@SDE WYDOT County Roads, Highways; http://www.fs.fed.us) to mxd. Some of the forests have separate files for Roads and for Trails; some are combined. For the combined files, split out the roads by the CFF field. Create buffer around roads at 0.25 miles. Clip and erase 'Low Flow' file for the buffer. Add 'Roads' field to 'Low Flow' attribute table. For 'Low Flow' segments within buffer, assign 'Yes' to attribute table. Merge back into one file.

9. Add Landownership (WDEQ@SDE WY_NamedLandowner) to mxd. Split Landowner file into 2 files: 'Public Land' and 'Private Land'. ('Open Water' layer was identified as public or private by surrounding land). Clip and erase 'Low Flow' file for 'Public Land'. Add 'PublicLnd' field to 'Low Flow' attribute table. For 'Low Flow' segments within boundary, assign 'Yes' to attribute table. Merge back into one file.

10. Add Trailheads (http://www.fs.usda.gov/main/r2/landmanagement/gis , http://www.fs.usda.gov/main/r4/landmanagement/gis, BLM field office data) to mxd. Merge into one file. Select sites on Public Land and within Roads buffer. Export selected sites to new file. Create buffer around trailheads at 0.5 miles. Clip and erase 'Low Flow' file using buffer. Add 'Trailhead' field to 'Low Flow' attribute table. For 'Low Flow' segments intersecting buffer, assign 'Yes' to attribute table. Merge back into one file.

11. Add Dispersed Campsites to mxd – individual forests sent data; gathered missing areas by GPS. Select sites on Public Land and within Roads buffer. Export selected sites to new file. Create buffer around sites at 0.5 miles. Clip and erase 'Low Flow' file using buffer. Add 'DispCamp' field to 'Low Flow' attribute table. For 'Low Flow' segments within buffer, assign 'Yes' to attribute table. Merge back into one file.

12. Select all 'Low Flow' segments with 'Yes' in at least 3 of the access fields (PopDens, School, Campground, NatRecArea, Parks, Trailhead, DispCamp), export selected segments to 'Primary Due to Access' file. Switch selection and export selected segments to 'LowFlow2' file.

13. Using 'LowFlow2' file select segments which extend two primary segments (from either 'Primary Due to Flow' or 'Primary Due to Access' files) separated by an isolated secondary (low flow) segment and extend side channels of braided primary flowlines. Export selected segments to 'Primary Due to Extension' file. Switch selection and export selected segments to 'Secondary' file.

14. Based on location information for Wild and Scenic River segments (http://www.rivers.gov/wyoming.php), select any wild and scenic designated segments identified as secondary. Export selected segments as the 'Primary Due to Wild and Scenic' file. Assign 'Primary Due to Wild and Scenic' to the 'StrmType' field and 'Primary' to the 'RecUse' field. Use the 'Primary Due to Wild and Scenic' file to erase these flowlines from the 'Secondary' file.

15. Add National Parks (http://www.nrdata.nps.gov), Wilderness Areas (http://www.wilderness.net/NWPS/geography) and Fish Creek drainage (digitized by WDEQ) to the mxd. Merge files to create the "Class 1 Region' file. Use the 'Class 1 Region' file to clip all flowline files. Using information from Chapter 1, Appendix A of Wyoming Water Quality Rules and Regulations, select and export individual Class 1 segments that fall outside of the 'Class 1 Region.' Merge all clipped and selected flowline files to create the 'Class 1 Flowline' file. In the 'Class 1 Flowline' attribute table, assign 'Class1' to the 'RecUse' field. Use the 'Class 1 Flowline' file to erase these segments from all other flowline files. For lakes, clip the NHD Waterbodies with the 'Class 1 Region' to create the 'Class 1 Lake' file.

16. Add 'Wind River Indian Reservation' to mxd. Use the file to clip all flowline files. Merge all clipped flowline files to create the 'Indian Country Flowline' file. In the 'Indian Country Flowline' attribute table, assign 'Indian' to the 'RecUse' field. Use the 'Indian Country Flowline' file to erase these segment from all other flowline files.

For lakes, clip the NHD Waterbodies with the 'Wind River Indian Reservation' to create the 'Indian Country Lake' file.

17. Merge and dissolve all buffer clips with 'Yes' in attribute table for Census Blocks, Schools, Campgrounds, Natural Areas, Parks, Monuments, Trailheads, and Dispersed Campsites to create a preliminary 'Primary Area' file. Erase the 'Class 1 Region' and 'Wind River Indian Reservation' land areas from the file to create the final 'Primary Area' file.

APPENDIX C. WDEQ AND WACD SURVEY WORKSHEETS

Figure C-1. WDEQ Recreation Site Survey Worksheet.

Segment ID _____

Wyoming Department of Environmental Quality, Water Quality Division

Recreational Use UAA Survey Worksheet

Department worksheet for calibrating model.

Date _____ Observer(s) _____

Time _____ River Basin (6-digit HUC number) _____

Waterbody Name _____ Watershed (8-digit HUC number) _____

Survey Location Description, including land ownership _____

_____

County _____ Elevation (ft) _____

Latitude*(WDEQ) _____ Longitude*(WDEQ) _____

Latitude*(CD) _____ Longitude*(CD) _____

GPS Datum and Coordinate System _____

Photo identification

1 _____ 2 _____

3 _____ 4 _____

Photo notes: _____

_____

Answer each of the following questions with either a *yes* or *no*:

1. _____ Is the survey location within a designated federal, state, or local park or recreational area? (*Federal, state or local parks should not be construed to mean all public lands, but rather, specifically developed and/or designated recreational use areas such as campgrounds, picnic grounds, trailheads, greenways, etc.*)

2. _____ Is the survey location part of a lake, reservoir or other still body of water. *(Exclude small (less than 1 square acre) stock watering ponds and waste effluent treatment ponds).*

3. _____ Is the survey location contained within a municipality or unincorporated high density housing area.

4. _____ Is the survey location on a water that is a larger perennial stream or game fishery known to be used by sportsmen or other recreationists?

1

Segment ID _____

5. _____ Is the survey location either currently known to be *or* do you believe that it has a reasonable potential to be used for recreational activities such as fishing, swimming, floating, rafting, canoeing or kayaking?

6. _____ Are there any schools within view of the survey location?

7. _____ Is there currently water within the surveyed stream, lake, reservoir or wetland?

8. _____ Does the survey location occur on public land?

9. _____ Are there any major recreational trails, trailheads or developed campgrounds within view of the survey location?

10. _____ Modeled as Primary Stream?

11. _____ Assessed on a Primary Segment (as modeled)?

Primary characteristics observed: _____

_____

_____

_____

Secondary characteristics observed: _____

_____

_____

_____

Appropriate stream classification assigned by model? Yes _____ No _____

Notes: _____

_____

_____

_____

_____

2

Figure C-2. WACD Recreation Site Survey Worksheet.

Wyoming Department of Environmental Quality, Water Quality Division

Recreational Use UAA Survey Worksheet

Each of Wyoming's 34 Conservation Districts has been provided with a randomly generated list of *survey locations* occurring on waters within their district. Each *survey location* refers to a single set of randomly generated latitude and longitude coordinates provided by WDEQ. The information gathered during this statewide survey will ultimately be compared to the predictions of a Geographic Information System (GIS) based Recreational Use Model that is currently being developed by WDEQ. Please fill out a separate worksheet completely for each survey location.

Date _____ Observer(s) _____

Conservation District _____ River Basin (6-digit HUC number) _____

Waterbody Name _____ Watershed (8-digit HUC number) _____

Survey Location Description, including land ownership _____

_____

County _____ Elevation (ft) _____

Latitude*(WDEQ) _____ Longitude*(WDEQ) _____

Latitude*(CD) _____ Longitude*(CD) _____

GPS Datum and Coordinate System _____
(Datum: NAD 83 [alternative WGS 84], Coordinate: UTM [12 - west part of state, 13 – east part of the state] are the preferred GPS settings)

*Please record both the coordinates supplied by WDEQ (on left above) and the coordinates observed using GPS in the field by CD personnel to verify that the correct survey location was visited.

Photographs (Please take one digital photograph looking upstream and one looking downstream from each survey location. Photo names should include the water's name and a unique number):

_____

Answer each of the following questions with either a *yes* or *no*:

1. _____ Is the survey location within a designated federal, state, or local park or recreational area? (*Federal, state or local parks should not be construed to mean all public lands, but rather, specifically developed and/or designated recreational use areas such as campgrounds, picnic grounds, trailheads, greenways, etc.*)

2. _____ Is the survey location part of a lake, reservoir or other still body of water. *(Exclude small (less than 1 square acre) stock watering ponds and waste effluent treatment ponds).*

3. _____ Is the survey location contained within a municipality or unincorporated high density housing area.

4. _____ Is the survey location on a water that is a larger perennial stream or game fishery known to be used by sportsmen or other recreationists?

5. _____ Is the survey location either currently known to be *or* do you believe that it has a reasonable potential to be used for recreational activities such as fishing, swimming, floating, rafting, canoeing or kayaking?

6. _____ Are there any schools within view of the survey location?

7. _____ Is there currently water within the surveyed stream, lake, reservoir or wetland?

8. _____ Does the survey location occur on public land?

9. _____ Are there any major recreational trails, trailheads or developed campgrounds within view of the survey location?